37141A

MFR 12
Protection Relay

Manual
Version 1.9xxx / 2.0xxx / 2.1xxx / 3.0xxx / 3.1xxx

Manual 37141A

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

CAUTION

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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Important definitions

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.

NOTE

Provides other helpful information that does not fall under the warning or caution categories.

Revision History

Rev.	Date	Editor	Changes
NEW	02-10-24	Tr	Release
A	07-07-19	TP	Update to reflect new format, minor corrections, and language revision

INACTIVE – FOR REFERENCE ONLY

The information in this publication is no longer current, and may not reflect changes or safety issues that have occurred since the publication was originally released.

Refer to the MFR 12 Packages manual 37352 for more recent information about the MFR 12 unit.

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Illustrations

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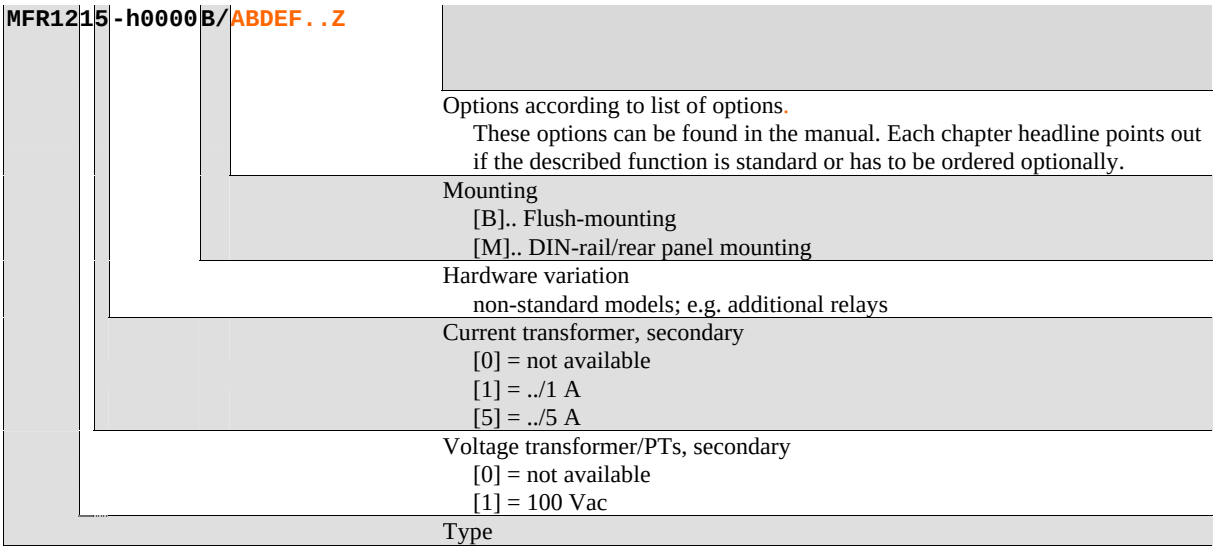
Chapter 1.
General Information

Introduction

The MFR 12 model is a complete generator protection unit packaged into one compact device. Typical applications are generators and switchgear equipment that require independent protection architecture. Different packages offer additional functionality.

The detailed model description for the MFR 12 reads as follows:



Examples:

- MFR1205B/IS (flush mounted, standard unit with ../5 A CT inputs with the Option IS [independent time-overcurrent, ground fault (calculated), 3 relay outputs])
- MFR1211B/IS/IU/R (flush mounted, standard unit with 100 Vac PT and ../1 A CT inputs with the Options IS/IU/R [inverse time-overcurrent, inverse time-overcurrent with voltage restraint, ground fault (calculated), 8 relay outputs])

Measurement Value Logging

Voltage

Option IR, IU: Voltage dependent time-overcurrent.

Current

Option IS, IZ: Three-phase measurement of the r.m.s. value.

- ../1 A..... [1]
- ../5 A..... [5]

Ground Current

The displayed ground current is digitally filtered from the measured currents. This prevents inaccurate values caused by the oscillations of the sine wave associated with ground fault currents from being displayed.

Option IS: The ground fault current is a calculation of the three phase currents vectorial sum.
This measurement is suitable for line-to-ground monitoring in rigid or half-rigid earthen mains (e.g. In phase-to-phase low voltage mains). The measured line-to-ground current should be at least 10% of the current transformer's rated current to ensure proper protection.

Option IKN: The ground fault current is a direct measurement of the single-phase ground current.
This measurement is suitable for line-to-ground monitoring in rigid or half-rigid earthen mains (e.g. in phase-to-phase low voltage mains). In addition single-phase current transformers in the mains star point, in Holmgreen connection or cable-type current transformers are used for the measuring current.

Option IK: The ground fault current is a direct measurement of ground current via cable-type current transformer.
This measurement is suitable for the line-to-ground protection in insulated or balanced mains in which very few ground currents appear. In addition cable-type current transformers or balanced transformers in Holmgreen connection are used for the measuring current.

Displacement Voltage

Option IV: The ground fault current is a direct measurement of the displacement voltage.
The measurement is carried out via the open delta winding (e-n-winding) of a voltage transformer or via a zero-point transformer in the generator star point.

Extent of Functions

Depending on the model, the unit is equipped with the following functions

Function	Option	Package			
		CP	51V	IvIkR	50-51GN
General functions					
Max 7 relay outputs freely configurable (5 change-over contacts, 2 NO contacts)	R		✓	✓	
1 ready for operation relay output (normally open contact)	Standard	✓	✓	✓	✓
Discrete input for blocking of protective functions or remote acknowledgment	Standard	✓	✓	✓	✓
1 Analog output - 20/0/4 to +20 mA	A1				
1 Analog output - 10/0 to 10 V	A2				
3 Analog outputs - 20/0/4 to +20 mA	A3				
4 Analog outputs -10/0 to 10 V	A4				
6 Analog outputs -20/0/4 to +20 mA	A6				
8 Analog outputs -10/0 to 10 V	A8				
Interface, uni-directional	SU				
Interface, bi-directional	SB				
Interface, CAN bus incl.remote control	SF				
Wide-range voltage input (75 to 265 Vac or 90 to 300 Vdc)	N				

[#] = RS-485/Modbus RTU Slave

Protective functions						
Independent time-overcurrent monitoring	I>, I>>	IZ	✓	✓		
Inverse time-overcurrent monitoring (according to IEC255) [#1]	I_a>>	IU		✓		
Inverse time-overcurrent monitoring with voltage restraint	I> (V<)	IU		✓		
Non-directional ground fault monitoring via displacement voltage	V_E>	IV			✓	
Ground fault monitoring, calculated from $I_{L1}+I_{L2}+I_{L3}$	I_E>>	IS	✓	✓		
Directional ground fault monitoring [#2]	I_E>, I_E>>	IK			✓	
Ground fault monitoring, measured via cable-type current transformer	I_E>, I_E>>	IS/IR			✓	
Ground fault monitoring, measured via current transformer	I_E>, I_E>>	IKN				✓

Packages					
MFR 12 with Options IS		✓			
MFR 12 with Options IS/IU/R			✓		
MFR 12 with Options IV/IK/R				✓	
MFR 12 with Options IKN					✓

#1 only when inverse time-overcurrent monitoring with voltage restraint is disabled
#2 only when ground fault monitoring via cable-type current transformer and non-directional ground fault monitoring are en

Intended Use The unit must only be operated in the manner described by this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

NOTE

This manual has been developed for all available packages. Inputs/outputs, functions, configuration screens, and other details described, which do not exist on your unit, may be ignored.

The present manual has been prepared to enable the installation and commissioning of the unit. Due to the large variety of parameter settings, it is not possible to cover every combination. The manual is therefore only a guide. In case of incorrect entries or a total loss of functions, the default settings may be taken from the list of parameters enclosed at the rear of this manual.

Chapter 2.
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control, modules, and work area as much as possible.

4. **Opening the control cover may void the unit warranty.**
   Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

   - Ensure that the device is completely voltage-free (all connectors have to be disconnected).
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Chapter 3.
Installation

Wiring Diagram up to Version 1.9xx / 2.0xx

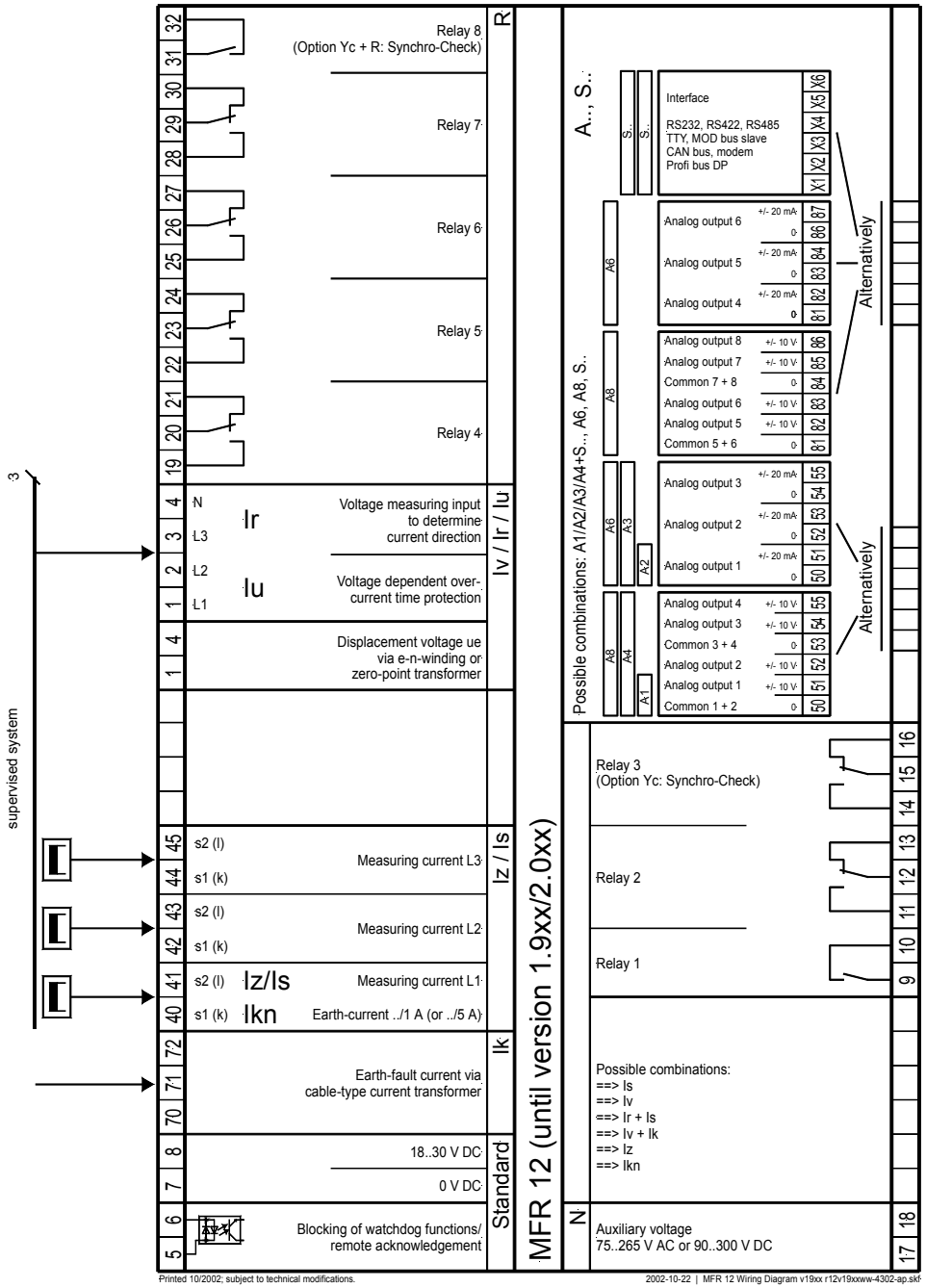


Figure 3-1: Wiring diagram up to Version 1.9xx / 2.0xx

Wiring Diagram from Version 3.0xx

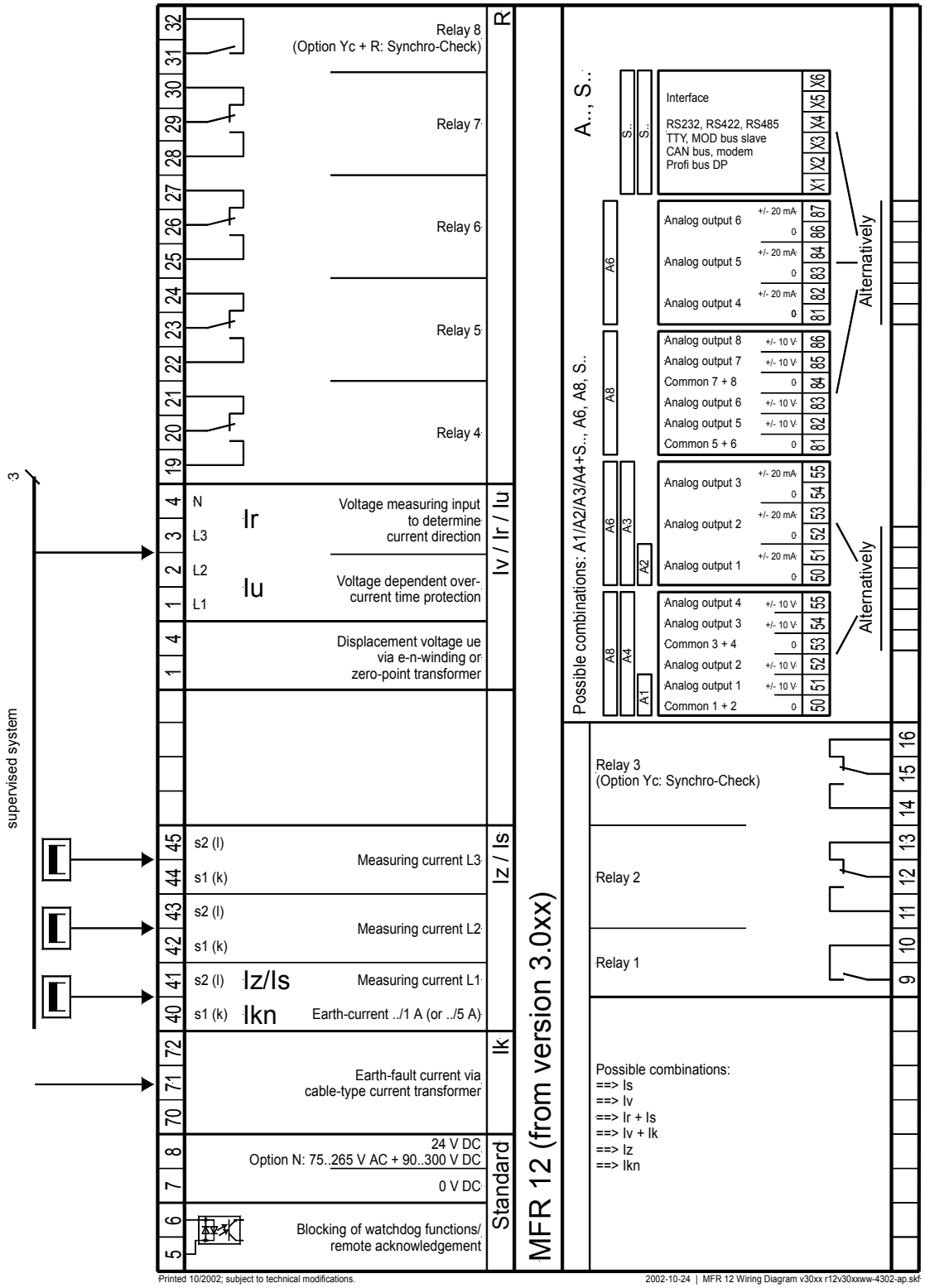


Figure 3-2: Wiring diagram from Version 3.0xx

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated under Technical Data on page 64 are valid!

CAUTION

A circuit breaker must be provided near to the unit and in a position easily accessible to the operator. This must also bear a sign identifying it as an isolating switch for the unit.

NOTE

Inductive devices connected to the system (such as operating current coils, undervoltage tripping units, or auxiliary/power contacts) must be connected to a suitable interference suppressor.

The following chart may be used to convert square millimeters [mm²] to AWG and vice versa:

AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
30	0.05	21	0.38	14	2.5	4	25	3/0	95	600MCM	300
28	0.08	20	0.5	12	4	2	35	4/0	120	750MCM	400
26	0.14	18	0.75	10	6	1	50	300MCM	150	1000MCM	500
24	0.25	17	1.0	8	10	1/0	55	350MCM	185		
22	0.34	16	1.5	6	16	2/0	70	500MCM	240		

Table 3-1: Conversion chart - wire size

Power Supply (Standard)

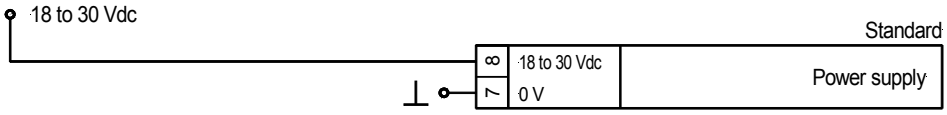


Figure 3-3: Power supply

Terminal	Description	A_{max}
Standard power supply unit (Standard)		
8	18 to 30 Vdc	2.5 mm²
7	0 V reference point	2.5 mm²

Wide Range Power Supply (Option N)

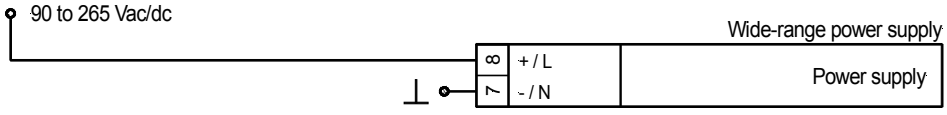


Figure 3-4: Wide range power supply

Terminal	Description	A_{max}
from Version 3.xxx - Wide range power supply unit (Option N)		
8	90 to 265 Vac/dc	2.5 mm²
7	0 V reference point	2.5 mm²
up to Version 1.xxx / 2.xxx - Wide range power supply unit (Option N)		
17	90 to 265 Vac/dc	2.5 mm²
18	0 V reference point	2.5 mm²

Measuring Inputs

Current

WARNING

Prior to disconnecting the current transformer connections or the connections of the transformer which are located at the unit, make sure that the transformer is short-circuited.

NOTE

Grounding of the secondary of a current transformer must always be single-sided.

Overcurrent, Line-to-Ground Protection (Options IZ and IS, Option IKN not possible)

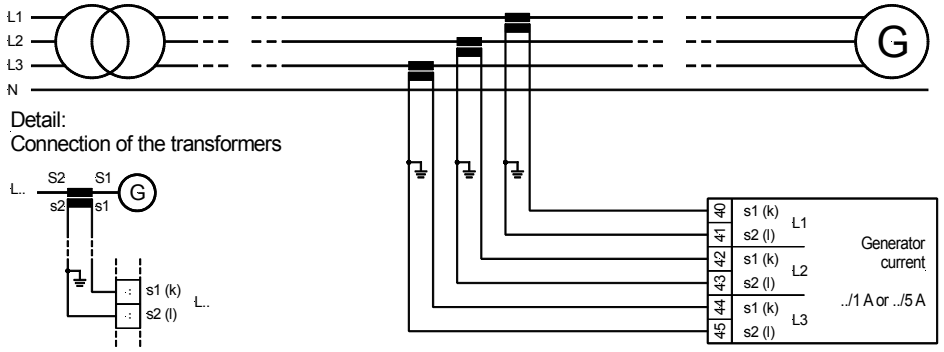


Figure 3-5: Measuring inputs - Current

Terminal	Measurement	Description	A_{max}
40	Transformer ../1 A or ../5 A	Generator current L1, transformer terminal s1 (k)	4 mm²
41		Generator current L1, transformer terminal s2 (l)	4 mm²
42		Generator current L2, transformer terminal s1 (k)	4 mm²
43		Generator current L2, transformer terminal s2 (l)	4 mm²
44		Generator current L3, transformer terminal s1 (k)	4 mm²
45		Generator current L3, transformer terminal s2 (l)	4 mm²

NOTE

The current transformers installation location will determine the protection area of the ground fault monitoring.

Ground Current for Low-Impedance or Solidly Grounded Systems (Option IKN, Option IZ/IS n. pos.)

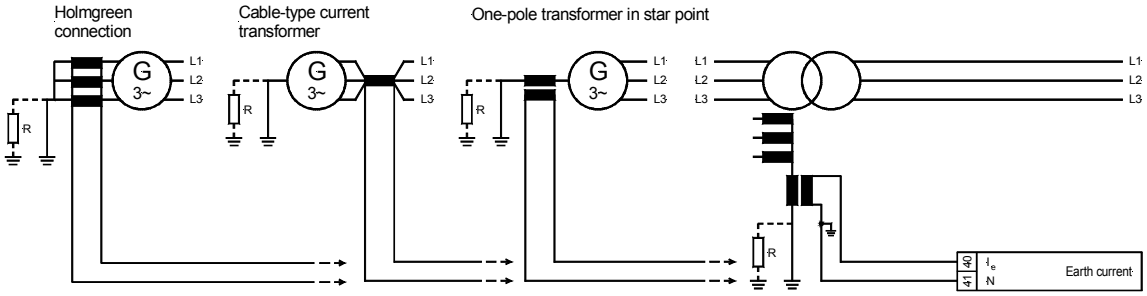


Figure 3-6: Measuring inputs - Connections

Terminal	Measurement	Description	A_{max}
40	via Holmgreen Connection	Ie (Ground current)	4 mm²
41		N	4 mm²
40	via cable-type current transf.	Ie (Ground current)	4 mm²
41		N	4 mm²
40	via one-pole transformer	Ie (Ground current)	4 mm²
41		N	4 mm²

NOTE

The current transformers installation location will determine the protection area of the ground fault monitoring.

Ground Current for Isolated or Balanced Networks (Option IK)

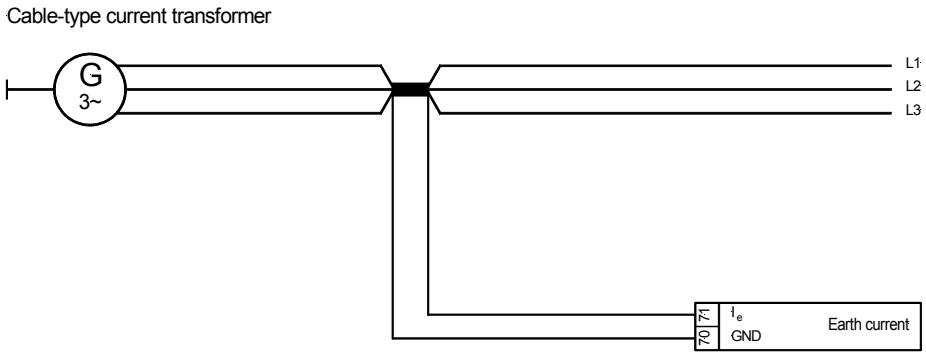


Figure 3-7: Measuring inputs - Connection

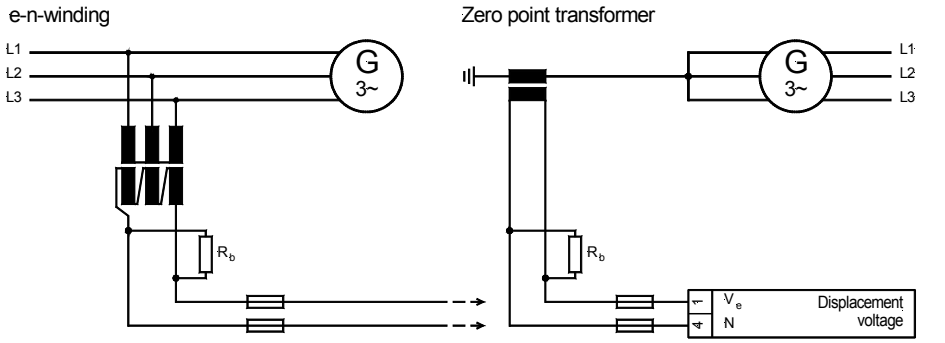
Terminal	Measurement	Description	A_{max}
71	Transformer	Ground current Ie	2.5 mm²
70	../1 A or ../5 A	GND	2.5 mm²

Voltage

Neutral Voltage Displacement (Option IV - Options IU, IR not available)

WARNING

Voltage dividers must be utilized on voltage potential transformers that have secondary outputs greater than 100 Vac.



R_b = Loading resistor

Figure 3-8: Measuring inputs - Displacement voltage

Terminal	Measurement	Description	A_{max}
Zero point transformer			
1	via zero point transformer	Ve (displacement voltage)	2.5 mm²
4		N	2.5 mm²
Open e-n-winding			
1	via e-n-winding	Ve (displacement voltage)	2.5 mm²
4		N	2.5 mm²

Reference Voltage (Options IR, IU)

NOTE

The reference voltage is used as overcurrent tripping depending on the monitored undervoltage and as overcurrent tripping depending on the direction.

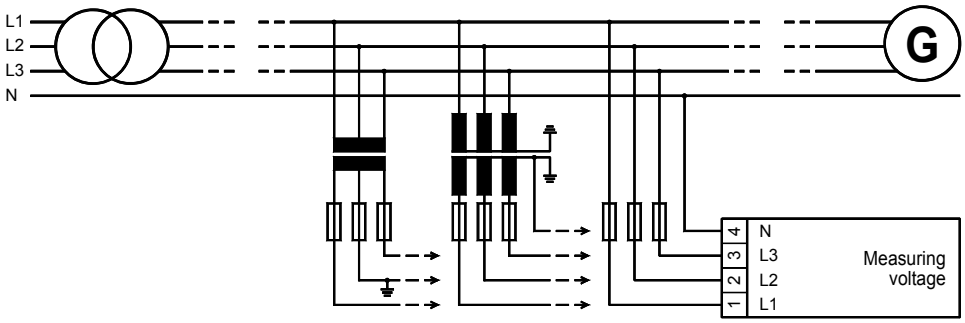


Figure 3-9: Measuring inputs - Reference voltage

Terminal	Measurement	Description	A_{max}
1	400V direct or via transd. ../100V	Measuring voltage L1	2.5 mm²
2		Measuring voltage L2	2.5 mm²
3		Measuring voltage L3	2.5 mm²
4		Star point of three-phase current system/ meas. transf.	2.5 mm²

Discrete Inputs

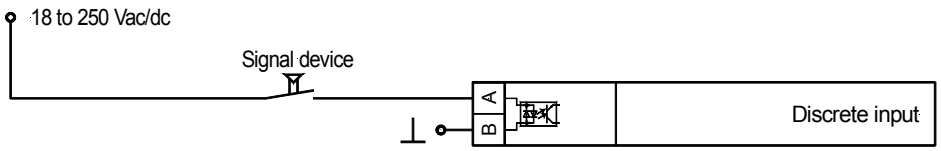


Figure 3-10: Discrete inputs

Terminal	Assigned common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***		
5	6	Blocking of protective device / remote acknowledgement	2.5 mm²

Outputs

Relay outputs (Standard / Option R)

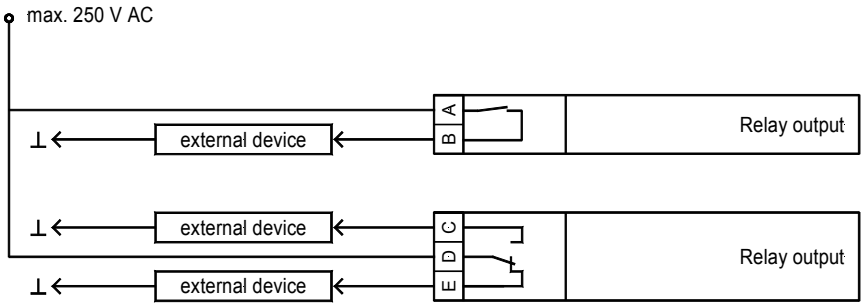


Figure 3-11: Relay outputs

			Description	
Make-contact				A_{max}
root ***A***	closing ***B***			
9	10		Relay 1	2.5 mm²
31	32		Relay 8 Option R	2.5 mm²
Change-over contact				
closing. ***C***	root ***D***	opening ***E***		
11	12	13	Relay 2	2.5 mm²
14	15	16	Relay 3	2.5 mm²
19	20	21	Relay 4 Option R	2.5 mm²
22	23	24	Relay 5 Option R	2.5 mm²
25	26	27	Relay 6 Option R	2.5 mm²
28	29	30	Relay 7 Option R	2.5 mm²

Analog Outputs (Options A1 to A8)

Possible combination The analog outputs and the interface may be combined as follows:

Option ...	S	A1 to A4	A6 to A8
without Option IK simultaneous use of ...	•	•	-
	-	-	•
with Option IK simultaneous use of ...	•	-	-
	-	•	-

NOTE

All 20 mA outputs are metallically separated each; the 10 V-outputs 1 to 4 and 5 to 8 are each isolated separated once.

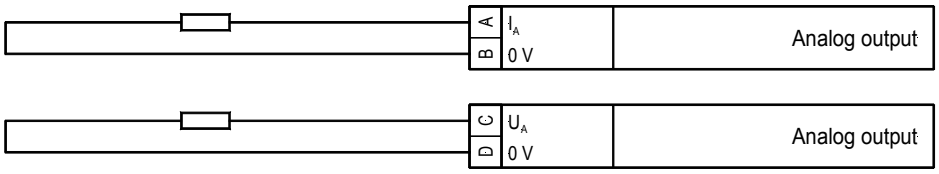


Figure 3-12: Analog outputs

		Description	A_{max}
0 to 20 / 4 to 20 / -20 to +20 mA ***I_A*** ***A***	***0 V*** ***B***		
51	50	Analog output 1 Option A2/3/6	1.5 mm²
53	52	Analog output 2 Option A3/6	1.5 mm²
55	54	Analog output 3 Option A3/6	1.5 mm²
82	81	Analog output 4 (Option IK: No. 1) Option A6	1.5 mm²
84	83	Analog output 5 (Option IK: No. 2) Option A6	1.5 mm²
87	86	Analog output 6 (Option IK: No. 3) Option A6	1.5 mm²
0 to 10 / -10 to +10 V ***V_A*** ***C***	***0 V*** ***D***		
51	50	Analog output 1 Option A1/4/8	1.5 mm²
52		Analog output 2 Option A4/8	1.5 mm²
54	53	Analog output 3 Option A4/8	1.5 mm²
55		Analog output 4 Option A4/8	1.5 mm²
82	81	Analog output 5 (Option IK: No. 1) Option A8	1.5 mm²
83		Analog output 6 (Option IK: No. 2) Option A8	1.5 mm²
85	84	Analog output 7 (Option IK: No. 3) Option A8	1.5 mm²
86		Analog output 8 (Option IK: No. 4) Option A8	1.5 mm²

Interface (Options SU/SB/SF)

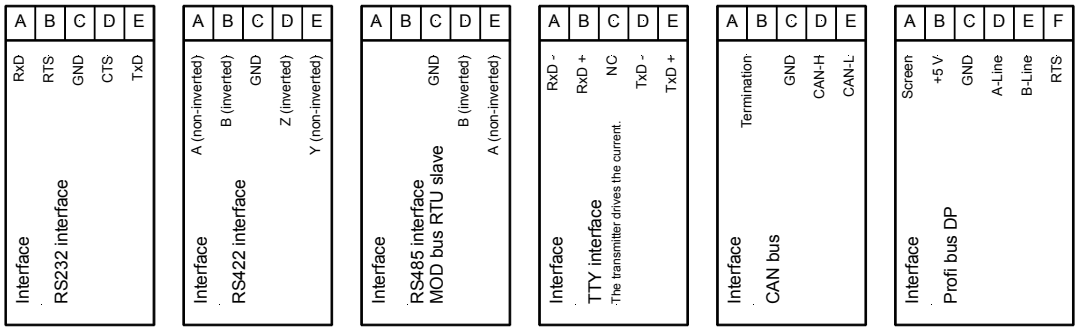


Figure 3-13: Interfaces

Terminal					Description
A (X1)	**B** (X2)	**C** (X3)	**D** (X4)	**E** (X5)	
RxD	RTS	GND	CTS	TxD	RS-232
A	B	GND	Z		RS-422
		GND	B	A	RS-485, Modbus RTU Slave
RxD-	RxD+	NC	TxD-	TxD+	TTY (transmitter drives current)
		GND	CAN-H	CAN-L	CAN bus

A (X1)	**B** (X2)	**C** (X3)	**D** (X4)	**E** (X5)	**F** (X6)	
Screen	+5 V	GND	A-Line	B-Line	RTS	Profibus DP (the file LEON00D9.GSD has to be used)

CAN Bus Shielding

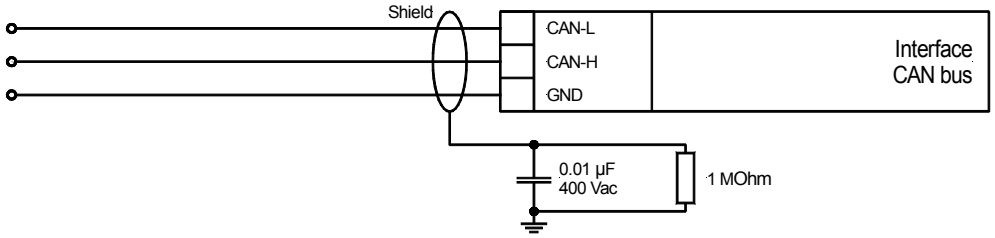


Figure 3-14: Interface - CAN bus shielding

CAN Bus Topology

NOTE

Please note that the CAN bus must be terminated with an impedance which corresponds to the wave impedance of the cable (e.g. 120 Ω). The CAN bus is terminated between CAN-H and CAN-L.

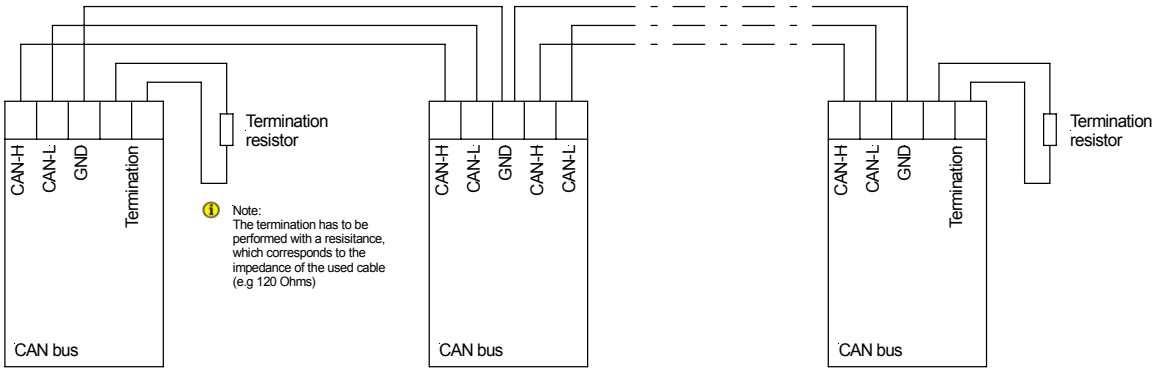


Figure 3-15: Interfaces - CAN bus topology

Possible CAN Bus Problems

If no data is transmitted on the CAN bus, check the following for common CAN bus communication problems:

- T structure bus is utilized (stub-end feeders or branch lines are not recommended)
- CAN-L and CAN-H are interchanged
- Not all devices on the bus are using identical Baud rates
- Terminating resistor(s) is/are missing
- Incorrect baud rate (too high) for length of CAN bus

Maximum CAN Bus Length

The maximum length of the communication bus wiring is dependent on the configured Baud rate. Refer to Table 3-2 for the maximum bus length (Source: CANopen; Holger Zeltwanger (Hrsg.); 2001 VDE VERLAG GMBH, Berlin und Offenbach; ISBN 3-8007-2448-0).

Baud rate	Max. length
1000 kbit/s	25 m
800 kbit/s	50 m
500 kbit/s	100 m
125 kbit/s	250 m
50 kbits/s	1000 m
20 kbit/s	2500 m

Table 3-2: Maximum CAN bus length

The maximum specified length for the communication bus wiring might not be achieved if poor quality wire is utilized, there is high contact resistance, or other conditions exist. Reducing the baud rate may overcome these issues.

DPC - Direct Configuration Interface

NOTE

Configuration with the direct configuration cable DPC (P/N 5417-557) is possible. A laptop/PC, the DPC cable, the program LeoPC1 version 3.1.1 or higher (included on CD Rom with unit), and the proper configuration files are required. Please consult the online help installed when the program is installed for a description of the LeoPC1 program and its setup.

WARNING

Only the DPC cable may be connected to the DPC interface. If other devices or lines are connected, the unit may be destroyed. Especially the connection of live lines (like phone lines) will destroy the unit.

CAUTION

The connection cable delivered with the DPC must be used between DPC and the unit to ensure proper functionality of the unit. An extension or utilization of different cable types for the connection between the unit and DPC may result a malfunction of the unit. This may possibly result in damage to components of the system. If an extension of the data connection line is required, only the serial cable (RS-232) between DPC and laptop/PC may be extended. It is recommended to use an industry standard cable for this.

NOTE

If the parameter "Direct config." is enabled on the control, communication via the CAN bus interface on terminals X1/X5 is disabled.

If the control unit detects that the engine is running (ignition speed exceeded), the direct configuration port is disabled.

Chapter 4.
Functional Description

Functional Table

Monitoring Ve	Monitoring Ie	Line-to-ground flt. directional	DI Blocking	**Function**	**Message**
0	0	X	X		
0	1	X	0	Tripping Ie>	Ground fault current 1/2
0	1	X	1	Tripping Ie> blocked	
1	0	X	X	Tripping Ve	Line-to ground fault Ve
1	1	0	0	Tripping Ie (falls Ue>*), ungerichtet	Ground fault current 1/2
1	1	0	1	Tripping Ve>, Ie> blocked	Line-to-ground fault Ve
1	1	1	0	Tripping Ie>	Line-to-ground fault 1/2
1	1	1	1	Tripping Ve>, Ie> blocked	Line-to-ground fault Ve

*) By exceeding maybe relay output "Excitation line-to-ground fault Ve", no display message.

Application flow, if Ve and Ie were activated

Threshold Ve will be exceeded:
no display message if so relay message "Excitation line-to-ground fault Ve"

Threshold Ie will also be exceeded:
message "Line-to-ground fault", if setting Line-to-ground fault directional = ON with direction control

Control Inputs

Blocking of protective function / Remote acknowledgement
Terminal 5/6

Energizing this discrete input disables various protective functions. This functionality may be desired if the control is used for generator protection. This keeps the control from recognizing fault conditions (i.e. undervoltage, underfrequency) when the generator is not operating. If blocking of these protective functions is not required, the discrete input should not be connected to any potential source.

The following protective function cannot be blocked via this discrete input:

- **Non-directional ground fault monitoring via displacement voltage**

External acknowledgement of the relays via the discrete input "Blocking of protective device/remote acknowledgement"

If the unit should not automatically reset the relays after the fault is no longer present, the parameter "**Auto clearing Relays**" must first be configured "**OFF**" (refer to "Auto Acknowledgement of the Relay" on page 52).

```
External
Clearing  ON
```

OFF ..... Alarms that cannot be blocked will not automatically reset after the fault condition is no longer present. Pressing the "Clear" button resets the relays.

ON ..... All alarm messages are reset if terminals 5/6 ("Blocking of protective functions / remote acknowledgement") are energized. Alarms that cannot be blocked are only reset after the fault is no longer present.

Control Outputs

NOTE

Please also read the description of the relay manager in chapter "Changing the Relay Assignment (Relay Manager; Standard / Option R)" starting from page 54.

Relay 1
Terminal 9/10
Output relay (type: make contact, N.O.)
The "relay manager" controls this relay.

NOTE

The "ready for operation" function is always assigned to relay 1. However, other protective functions may also be assigned to relay 1 additionally. Relay 1 is always configured as Normally Closed (break contact) and will de-energize if the unit is not ready for operation.

Relay 2, 3
Terminal 11 through 16
Output relay (type: change-over contact)
The "relay manager" controls these relays.

Option R
Relay 4..7
Terminal 19 through 30
Output relay (version: make contact) - only, if Option R is available.
The "relay manager" controls these relays.

Option R
Relay 8
Terminal 31/32
Output relay (version: make contact) - only, if Option R is available.
The "relay manager" controls these relays.

Alarms

Alarm Messages

Table 4-1 contains a list of all alarm messages that the control may monitor for depending on how the unit is configured:

Alarm type		Alarm text
Independen time-overcurrent, level 1	Option IZ/IS	`Ov.curr. 1`
Independen time-overcurrent, level 2	Option IZ/IS	`Ov.curr. 2`
Independen time-overcurrent, level 3	Option IZ/IS	`Ov.curr. 3`
Inverse time-overcurrent with voltage restraint	Option IU	`I> (invers)`
Inverse time-overcurrent	Option IU	`I> (invers)`
Ground fault, level 1	Option IS/IK/IKN	`Earthcur.1`
Ground fault, level 2	Option IS/IK/IKN	`Earthcur.2`
Non-directional ground fault via displacement voltage	Option IV	`E.fault Ve`

Table 4-1: Alarms

Alarm Acknowledgement

A fault/alarm is indicated by the "Alarm" LED.

By pressing the "Clear" button, the active faults are acknowledged. The following distinction is made between fault conditions:

The fault ...

- **is still active** — As long as the fault is still present, it cannot be acknowledged. The flashing "Alarm" LED on the front panel indicates that the alarm is still active.

- **is no longer active** — When the active fault has been eliminated, the flashing "Alarm" LED changes to steady illumination. If the parameter "Auto clearing displays" is configured "ON", the LED extinguishes after the resetting time has expired. If the parameter "Auto clearing displays" is configured "OFF", the LED is extinguished only after pressing the "Clear" button.

Chapter 5.
Display and Operating Elements

The pressure-sensitive membrane of the front panel consists of a plastic coating. All keys have been designed as touch-sensitive membrane switch elements. The display is an LC-display, consisting of 2 rows of 16 characters each, with indirect green lighting. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the right side of the control. The configuration plug is located on the right side of the unit as well. Please connect the direct configuration cable there (DPC).

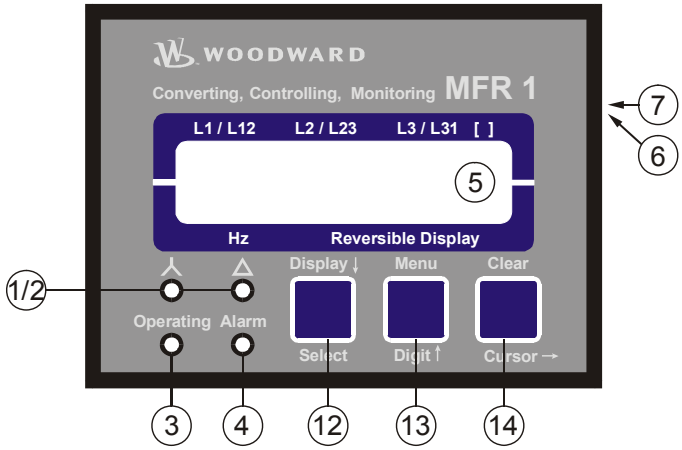


Figure 5-1: Front panel

Brief Description of LEDs and Push Buttons

LEDs

No.	Description	Function
1	"Wye"	Indication of the wye (star) voltages
2	"Delta"	Indication of the delta voltages
3	"Operating"	Automatic mode
4	"Alarm"	Alarm occurred

Push Buttons

No.	Description	Function
12	Display↓	Advance to next screen
12	Select	Confirm selection
13	Menu	Select menu
13	Digit↑	Increase the digit
14	Clear	Acknowledgement of alarm messages
14	Cursor→	Move cursor one position to the right

Miscellaneous

No.	Description	Function
5	LC Display	LC Display
6	Potentiometer	Adjust LCD contrast
7	DPC plug	Configuration plug

LEDs

NOTE

If neither of the "Wye" and "Delta" LEDs is illuminated, the first line of the display indicates the measured currents of the phases.

1 **"Wye"** Color: Yellow

Indication of the wye voltages

If this LED is illuminated, the values indicated on the display are the wye (star) voltages (phase-neutral).

2 **"Delta"** Color: Yellow

Indication of the delta voltages

If this LED is illuminated, the values indicated on the display are the delta voltages (phase-phase).

3 **"Operation "** Color: Green

Operation

This LED is illuminated constantly when the control unit is in the Automatic mode. If this LED is flashing, the control is in the configuration mode.

4 **"Alarm"** Color: Red

Alarm

This LED flashes as long as a set point limit is exceeded. When all measuring values are below the configured set point limits again and "Auto clearing display" is configured "OFF", this LED will change to steady illumination.

Push Buttons

In order to facilitate the setting of the parameters the buttons are equipped with an "AUTOSCROLL" function while the controller is in the configuration mode. It permits the user to rapidly advance to the next setting and configuration screens, the digits, or the cursor position. The "AUTOSCROLL" function will only be enabled when the user presses and holds the corresponding buttons.

12 **Display↓ / Select**
Color: none

Display↓ / Select

Automatic mode: Display↓ - By pressing this button, the user advances through the display of operating (wye voltages, delta voltages, wire currents) and alarm messages. The "Wye" and "Delta" LEDs are illuminated accordingly.

Configuration: Select - By pressing this button, the user advances to the next configuration screen. If the value originally displayed has been changed via the "Digit↑" or "Cursor→" push buttons, the newly set value is saved by pressing the "Select" push button once. By pressing the button again, the user causes the system to advance to the next configuration screen.

13 **Menu / Digit↑**
Color: none

Menu / Digit↑

Automatic mode: Menu - By pressing this button, the user advances through the messages displayed on the second line of the display. (Various measured values and any alarm messages that have not been cleared are indicated.)

Configuration: Digit↑ - By pressing this button, the digit at which the cursor is presently located is increased by one digit. The increase is restricted by the permissible limits (see list of parameters included in Appendix E). If the highest permissible number has been reached, the number automatically returns to the lowest permissible number.

14 **Clear / Cursor →**
Color: none

Clear / Cursor →

Automatic mode: Clear - Individual alarm messages are deleted by pressing this button provided the fault is no longer present.

Configuration: Cursor→ - This button moves the cursor one position to the right. When the cursor reaches the extreme right position it may be returned to the extreme left position by pressing the Cursor→ button again.

LC Display

5 LC Display LC display

Performance values can be monitored from the two-line display, provided that the control is in automatic mode. In configuration mode, the individual parameters are displayed.

Display in Automatic Mode (First Line of the Display: Measured Values)

NOTE

The user can scroll through the first display line with the button "Display ↓".

Display in automatic mode, first line: measured values

The following measured values are displayed (depending on the "Wye" and "Delta" LEDs):

- Option IZ, IS:
  The phase currents (I_{L1}, I_{L2} and I_{L3}) are displayed.

- Option IR, IU:
  - The "Wye" LED is illuminated, and the "Delta" LED is off.
    The wye (star) voltages (V_{L1-N}, V_{L2-N} and V_{L3-N}) of the four-wire system are indicated. If the application is a three-wire system, the configuration screen "**`Volt.-Measuring`**" must be configured to "**`phase to phase`**". The "Wye" LED will not illuminate in this application.
  - The "Wye" LED is off and the "Delta" LED is illuminated.
    The delta voltages (V_{L1-L2}, V_{L2-L3} and V_{L3-L1}) of the phase-to-phase system/phase - neutral system are indicated.
  - The "Wye" LED is off and the "Delta" LED is off.
    The phase currents (I_{L1}, I_{L2} and I_{L3}) are displayed

- Option IV, IK, IKN:
  No measured values are displayed. The message "Earth Fault mon." is displayed.

Option IZ, IS

"Wye" = off, "Delta" = off
Phase currents

```
453  452  454 A
----------------
```

Option IR, IU

"Wye" = on, "Delta" = off
Wye voltages

```
230  230  230 V
----------------
```

"Wye" = off, "Delta" = on
Delta voltage

```
400  400  400 V
----------------
```

"Wye" = off, "Delta" = off
Phase currents

```
314  314  314 A
----------------
```

Option IZ, IS

```
Earth fault pro.
----------------
```

Display in Automatic Mode (Second Line of the Display: Measured Values)

NOTE

The "Menu" button may be used to scroll through the messages shown on the second line of the display.

```
----------------
00.00 xxxxxxxxxx
```

Display in automatic mode, second line: Measuring Values

The frequency in [Hz] is always indicated.
Instead of "**xxxxxxxxxx**" the following measuring values are indicated:

• Displacement voltage Ve	Unit static in [%]	Option IV
• Ground current Ie	Unit static in [%]	Option IS, IKN
• Ground current Ie	Unit static in [0.01 %]	Option IK

Display in Automatic Mode (Second Line of the Display: Alarm Indication)

NOTE

The user may scroll through the alarm messages that have occurred with the "Menu" button.

```
----------------
00.00 yyyyyyyyyy
```

Display in automatic mode, second line: Alarm indication

If alarms do occur, the corresponding alarm message appears in the bottom line of the LC display according to the following list.

Alarm type		Alarm text
Independen time-overcurrent, level 1	Option IZ/IS	`Ov.curr. 1`
Independen time-overcurrent, level 2	Option IZ/IS	`Ov.curr. 2`
Independen time-overcurrent, level 2	Option IZ/IS	`Ov.curr. 3`
Inverse time-overcurrent with voltage restraint	Option IU	`I> (invers)`
Inverse time-overcurrent	Option IU	`I> (invers)`
Ground fault, level 1	Option IS/IK/IKN	`Earthcur.1`
Ground fault, level 2	Option IS/IK/IKN	`Earthcur.2`
Non-directional ground fault via displacement voltage	Option IV	`E.fault Ve`

Table 5-1: Alarms

Chapter 6.
Configuration

Configuration can be performed via the front panel push buttons and the front panel LC display or using a PC and the PC program LeoPC1 via the serial interface. If direct configuration via a PC is selected, the following baud rate is to be used:

- Configuration via direct configuration plug = 9,600 Baud (8 Bit, no parity, 1 stop bit)

CAUTION

Please note that configuration only should be done while the system is not in operation.

NOTE

A list of all parameters may be found in Appendix E of this manual.

You can advance through the individual parameter screens if you are in configuration mode (simultaneously pressing of "Digit↑" and "Cursor→" push buttons permits access to the configuration mode) by using the "Select" button. If you press and hold the "Select" push button, the scroll function will be activated, allowing for the parameter screens to be advanced through more rapidly. The control unit will permit the operator to reverse up to four previous screens (exception: it is not possible to reverse from the first parameter to the last parameter). To perform the reverse function through the parameter screens, the "Select" and "Cursor→" push buttons must be pressed and released simultaneously. The control unit will revert to automatic mode if an entry isn't performed, a change made, or any other action performed for 120 seconds.

```
Adjust Settings:
SELECT (ANWAHL)
```

Configuration mode **Button "Select"**

After the configuration mode is enabled, the subsequent screens can be viewed and modified within the preset limits. Please note, that by depressing the "Select" button, the following screens are advanced by one screen each. If a parameter is configured "OFF", the related screens are not displayed or monitored by the control. Pressing the "Select" button will advance the displayed screen to the next parameter.

Basic Data

```
Software version
      x.xxxx
```

Software version

This screen displays the software version loaded into the control (the last two xx are for software revisions which do not affect the function of the unit).

```
SPRACHE/LANGUAGE
---------------
```

Language selection **Deutsch/English**

The desired language for the controller to operate in is set by this parameter. The screens (configuration and display screens) can be displayed either in German or English.

Configuration Access

Sealing (Until Version 1.9xx)

NOTE

If no protection against modification of the setting values has been ordered, then it is advisable not to turn on the sealing function; Parameters on "OFF". If, on the other hand, a sealing function is necessary, it is advisable to activate it only after setup is complete!

➔ **SEQUENCE DIAGRAM on the following page!**

By entering a five-character code number, the input operation can be protected from unauthorized access, operation and modifications. The function represents the exact software emulation of a mechanical seal.

```
Encoding
            ON
```

Sealing function **ON/OFF**

ON .....The input of the following values is protected by a code word. The subsequent screens of this option are being displayed.
OFF .....There is no protection through sealing, and the subsequent screens of this option are not shown. (default)

```
Code no. 000
Code?      ?????
```

Sealing function **00000 to 60000**

Correct code If the code number has been correctly entered for the active seal, the values are entered in the sequence of the screens. (default 00100)
Wrong code .If the code number has been incorrectly entered for the active seal, the following seals are indicated.

```
Wrong Code
SELECT (ANWAHL)
```

Incorrect code was indicated **Button "Select"**

The code number for the active seal was incorrectly entered! Please confirm this message using the button "Select".

```
Code  no. 000
Break?      YES
```

Breaking the seal number XXX **YES/NO**

By entering "**YES**", you can break the seal and release the input mode. However, the sealing number is then increased by 1. Thus, it is possible at any time to check whether modifications have been made without the correct code number having been entered. If you select "**NO**" the code is inquired again. Leaving the inquiry is only possible by terminating input mode.


```
Code no. 000
New code:  ?????
```

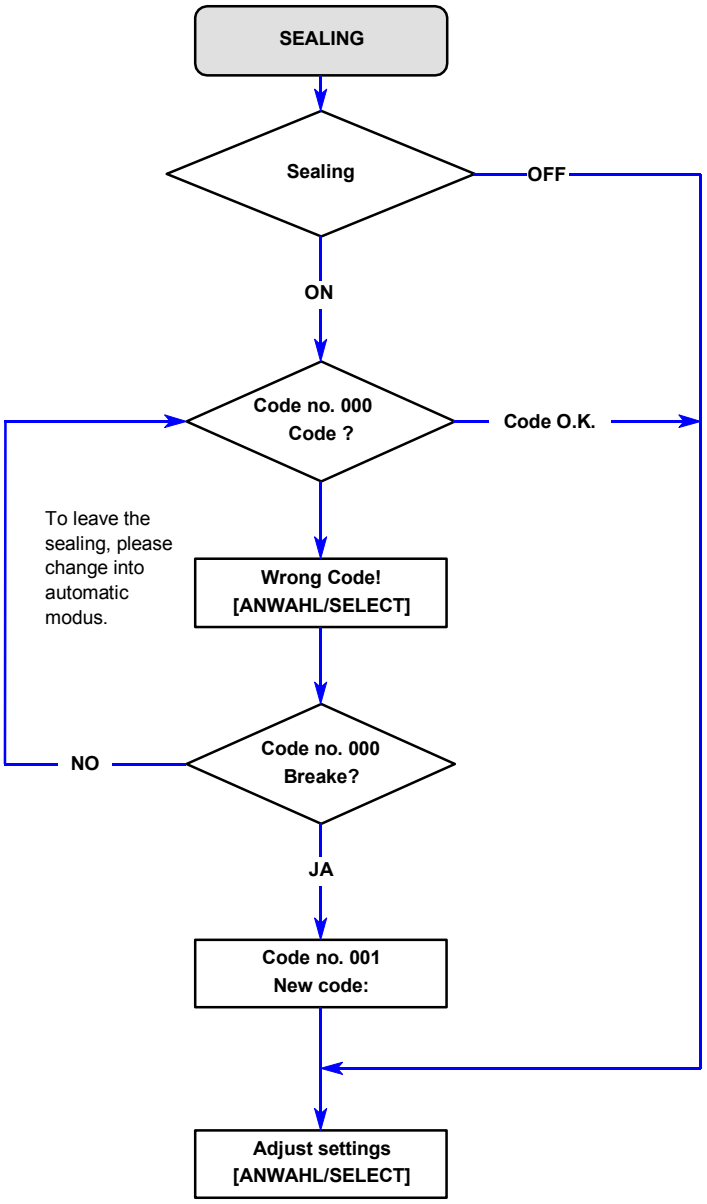
Code for seal 001 (new entry) **00000 to 60000**

After breaking the old seal, the unit requests the code number for the new seal. Sealing can now be effected with a new code number.

```
Adjust Settings:
SELECT (ANWAHL)
```

Enter values **Button "Select"**

Press the button "Select" for input.



Password (Starting with Version 2.0xx / 3.0xx)

The unit is equipped with a three-level code and configuration hierarchy, which allows different user access to the control. A distinction is made between:

Code level CS0 ***(User Level)*** Factory password = none
This code level allows for monitoring of the system and does not permit access to the parameters. Configuration is blocked.

Code level CS1 ***(Basic Service Level)*** Factory password = "**0 0 0 1**"
This code level entitles the user to change selected parameters, like setting Bar/PSI, °C/°F, and clock adjustment. Changing a password is not permitted at this level. This password expires two hours after entering the password and the user is returned to the CS0 level.

Code level CS2 ***(Commissioning Level)*** Factory password = "**0 0 0 2**"
Allows direct access to all parameters (displaying and changing). In addition, the user may also set the password for levels CS1 and CS2. This password expires two hours after entering the password and the user is returned to the CS0 level.

NOTE

Once the code level is set, it will not be changed even after entering the configuration repeatedly an incorrect code number has been entered, the code level is set to CS0, thus locking the device for external persons.

If for 2 hours uninterruptedly supply voltage is applied, the device automatically switches to code level 0.

NOTE (Starting with Version 2.1xx / 3.1xx)

The following configuration screen "Enter code number" only appears if the parameter "Password Protection" is configured "ON" (see below).

```
Enter code
number      0000
```

Enter code number **0000 to 9999**

Upon enabling the configuration mode, the user is required to enter an access code number, which identifies the various users. The displayed number XXXX is a randomly generated number. If the random number is confirmed by pressing the "Select" button without being changed, the current level of access maintained. Upon entering either a level 1 or level 2 access code, the corresponding level of access is granted. If an incorrect access code is entered the control unit changes to code level 0 and all access is blocked until a code level 1 or 2 access code is entered.

```
Password
Protection   ON
```

Password protection **ON/OFF**

ON .....Password protection is enabled. Configuration access is granted by entering the appropriate password (Code level 1/2). If an incorrect code number has been entered, configuration is blocked.

OFF .....Password protection is disabled. Access to configuration screens is permanently set to code level 2 and the code number is not queried. This parameter can only be changed if the code number of code level 2 has been entered.

Change Passwords (Starting with Version 2.0xx / 3.0xx)

```
Define level 1
code        0000
```

Define level 1 password **0000 to 9999**

This screen appears only when the level 2 password has been entered. After entering the digits into this screen, the code level for level 1 (basic service level) is set. After entering this code, the user only has the access rights assigned to this code level.
This code level (CS) is preset to **CS1 = 0 0 0 1**

```
Define level 2
code        0000
```

Define level 2 password **0000 to 9999**

This screen appears only when the level 2 password has been entered. After entering the digits into this screen, the code level for level 2 (comissioning level) is set. After entering the code, the user has the access rights with which he was assigned.
This code level (CS) is preset to **CS2 = 0 0 0 2**

Direct Configuration (from Version 3.0xx)

NOTE

A direct configuration cable DPC (P/N 5417-557), the LeoPC1 program (supplied with the cable) and the corresponding configuration files are required to perform direct configuration. After the program has been installed, consult the online help for a description of the PC program and its setup.

For configuration of the unit via PC program please proceed as follows:

- Install the PC program on your laptop/PC according to the installation manual.
- Before the end of the installation you are requested to select the language with which you want to start the PC program. You can change the language at any time. The selection of the language refers only to language with which the menus and subprograms of the PC program works. This setting will not change the language of the control unit being configured.
- After the installation of the PC program reboot your laptop/PC.
- Establish the connection between your laptop/PC and the unit via the DPC. Plug one side to the configuration plug of the unit and the other side to the COM1 port of your laptop/PC (other possibilities are described in the installation manual).
- You may start the PC program as follows:
  - by "Start/Program/Woodward/LeoPC" (starting at version 3.1.xxx), or
  - by a double click on a file ending ".cfg" in the subdirectory "LeoPC".
- After the PC program has been started, establish the communication by pressing the "F2" button. This will establish a data link between the unit and the laptop/PC.
- Start the sub program "Device Parameterization" and adjust the parameter of the unit to your application using this manual.

WARNING

If the following parameter "Direct parametr." is configured to "YES", communication via the interface with terminals X1 to X5 is disabled. If communication is to be re-established via interface X1 to X5 after the configuration the unit (e. g. CAN bus connection via a Gateway GW 4), the following parameter must be set to "NO"!

Moreover the following restrictions apply:

Option SU: Communication via the interface is locked.

Option A6: The analog outputs 3 to 6 are functionless during configuration.

Option A8 or A82: The analog outputs 5 to 8 are functionless during configuration.

If, after the configuration of the unit, communication via the interface should be re-established and the corresponding analog outputs should function again, the subsequent parameter must be set to "NO"!

```
Direct parametr.
            YES
```

Direct configuration **YES/NO**

YES .....Configuration via the configuration port is enabled. The following conditions must be met in order to carry out configuration via the direct configuration cable:
- A connection must be established via the direct configuration cable between the unit and the PC
- the Baud rate of the PC program must be set to 9,600 Baud
- the corresponding configuration file must be used (file name: "xxxx-xxxx-yyy-zz.asm", initiated by xxxx-xxxx-yyy-zz.cfg)

NO .....Configuration via the direct configuration port is disabled.

Measurement

WARNING

The following values must be entered correctly for the generator to be monitored. Failure to do so may lead to incorrect measuring of parameters resulting in damage to or destruction of the generator or switchgear and/or personal injury or death.

Voltage Measurement (Option IU, IR)

```
Volt.-Measuring
---------------
```

This screen only affects the displayed values. The protective functions are defined below.

Voltage measuring **Phase to phase / Phase neutral**

This parameter determines how the voltage is to be measured.

Potential Transformer Configuration (Option IU, IR)

```
Volt.transformer
secondary  000V
```

Potential transformer secondary **50 to 125 V**

The potential transformer secondary voltage is set here in V. This parameter is utilized to calculate the system voltage in the display. For voltages measured without a potential transformer, secondary and primary voltage must be configured the same.

```
Volt.transformer
primary 00.000kV
```

Potential transformer primary **00.100 to 65.000 kV**

The potential transformer primary voltage is set here in kV. This entry is used to show the system voltage in the display.

Example: If a voltage of 110 V is measured without a potential transformer, the secondary transformer voltage must be configured to **`110V`** and the primary transformer voltage must be configured to **`00.110V`**.

Current Transformer Configuration

```
Current transf.
          0000/0
```

Current transformer **1 to 9,999/{x} A**

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5A CT should output 3A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and may affect the functionality of the control.
The control may be ordered with either ../1 A or ../5 A current transformer inputs. The CT inputs will dictate how this parameter is displayed on the control. Information about the current transformers inputs may be found on the unit data plate.

{x} = 1 ..... MFR12x**1**B/xxx = Current transformer with ../1 A rated current
{x} = 5 ..... MFR12x**5**B/xxx = Current transformer with ../5 A rated current

Rated Values

```
Rated voltage
          000V
```

Rated voltage **5 to 125 V**

This parameter defines the system rated voltage.

```
Rated current
          0000A
```

Rated current **10 to 9,999 A**

The system current rating is defined in this parameter. Percentage values in the protective functions refer to this parameter.

```
Rated power
         00000kW
```

Rated power **5 to 32,000 kW**

The rated power is configured here. The exact value of the rated power is absolutely vital. Many measurement, control, and monitoring functions refer to this value.

Power Measurement

```
Power measuring
---------------
```

Power measurement **one-phase / three-phase**

Power measurement may be configured as single-phase or three-phase. If "single-phase power measurement" is set, the current and the voltage in phase L1 are used for power measurement. If "three-phase power measurement" is set, all three-phase currents and the relevant voltages are used for power measurement.

- one-phase power measurement:

$P = \sqrt{3} \times V_{L12} \times I_{L1} \times P.F\ (\cos\varphi)$

- three-phase power measurement:

$P = V_{L1N} \times I_{L1} \times P.F\ (\cos\varphi) + V_{L2N} \times I_{L2} \times P.F\ (\cos\varphi) + V_{L3N} \times I_{L3} \times P.F\ (\cos\varphi)$

Protection

Independent time-overcurrent protection (Option IS/IZ)

NOTE

All percentage values of the current refer to the rated current (page 37).

Function: Current is monitored depending on parameter "Overcurrent Monitoring". The time-overcurrent alarm contains three limits and can be setup as a step definite time overcurrent alarm as illustrated in the figure below. Monitoring of the maximum phase current is performed in three steps. Every step can be provided with a delay time independent of the other steps.

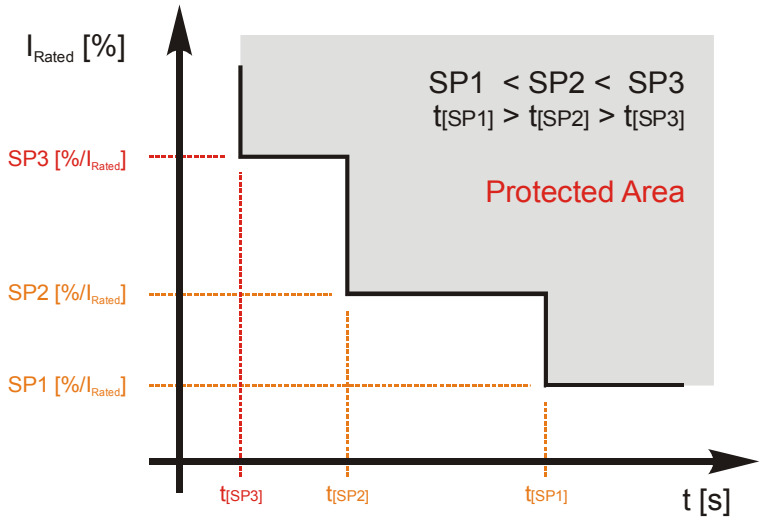


Figure 6-1: Diagram for independent time-overcurrent monitoring

```
Overcurrent
Monitoring  ON
```

Independent time-overcurrent monitoring **ON/OFF**

ON..... Independent time-overcurrent monitoring is enabled and the subsequent screens of this function are displayed.

OFF..... Independent time-overcurrent monitoring is disabled and the subsequent screens of this function are not displayed.

```
Overcurrent 1
         I> 000%
```

Threshold independent time-overcurrent, level 1 **0 to 300 %**

Overcurrent (level 1) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**`overcurrent 1`**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 1
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 1) alarm, the measured current must exceed and remain above the configured level 1 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent 2
        I> 100%
```

Threshold independent time-overcurrent, level 2 **0 to 300 %**

Overcurrent (level 2) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**overcurrent 2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 2
Delay     00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 2) alarm, the measured current must exceed and remain above the configured level 2 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent 3
        I> 100%
```

Threshold independent time-overcurrent, level 3 **0 to 300 %**

Overcurrent (level 3) is defined by this parameter. The percentage configured in this parameter refers to the configured rated system current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**overcurrent 3**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Overcurrent 3
Delay     00.00s
```

Pickup delay, level 3 **0.02 to 99.98 s**

In order to initiate an overcurrent (level 3) alarm, the measured current must exceed and remain above the configured level 3 threshold without interruption for at least the period of time specified in this screen.

```
Overcurrent
Hysteresis  000%
```

Hysteresis for the independent time-overcurrent monitoring, levels 1, 2 + 3 1 to 300 %

In order to prevent system fluctuations from continually initiating overcurrent alarms (levels 1, 2 + 3), a lower release point is defined here. If the control monitors the current above the permissible limit, the current must drop below that threshold and the current level defined here for the fault condition to be recognized as no longer existing.
Example: If a 1000A system has an overcurrent limit 1 of 110% (1100A) and a hysteresis of 105% (1050A), the monitored current for an overcurrent alarm must drop below 1050A to reset the alarm.

Inverse Time-Overcurrent Protection (Option IA)

NOTE

All percentage indications of the current refer to the rated current (see page 37).

NOTE

This monitoring function is only available if Inverse time-overcurrent with voltage restraint is disabled.

Function: Monitoring of overcurrents including inversely proportional time dependent tripping characteristic. The selected trip curve defines the tripping time according to the measured current. The tripping time will be decreased according to a defined curve the higher the measured current is. According to IEC 255 three different characteristics are available.

Normal inverse: $$t = \frac{0.14}{(I/I_P)^{0.02} - 1} * t_p[s]$$

Very inverse: $$t = \frac{13.5}{(I/I_P) - 1} * t_p[s]$$

Extremely inverse: $$t = \frac{80}{(I/I_P)^2 - 1} * t_p[s]$$

Formula definitions:

t:	tripping time
t_p	time set point value
I	fault current / monitored current
I_p	current set point value

If t is greater than 162 s the system trips at 162 s. If t is lower than t_{min} the tripping time is t_{min}. The reaction time for t_{min} depends on the time it takes to monitor the fault and the operating time of the relays. t_{min} is at least 20 ms.

Please consider during configuration:

for I_{start}: $I_{start} > I_n$ and $I_{start} > I_p$
for I_p the smaller I_p is, the steeper is the slope of the tripping curve

Configuration Screens

```
Inv.time ov.cur.
Monitor.     ON
```

Inverse time-overcurrent monitoring **ON/OFF**

ON .....Inverse time-overcurrent monitoring is enabled. The subsequent screens of this function are displayed.
OFF .....Inverse time-overcurrent monitoring is disabled. The subsequent screens of this function are not displayed.

```
Inv.time char.
---------------
```

Inverse time-overcurrent: characteristic **Normal / High / Extreme**

Normal. ....."Normal inverse" characteristic used
High....."Very inverse" characteristic used
Extreme ....."Extremely inverse" characteristic used

```
Inv.time ov.cur.
       Tp=0.00s
```

Inverse time-overcurrent: time constant Tp **0.01 to 1.99s**

The time constant for t_p is defined by this parameter.

```
Inv.time ov.cur.
      Ip=0.0*In
```

Inverse time-overcurrent: current constant Ip **0.1 to 3.0*In**

The current constant for I_p is defined by this parameter. This setpoint is dependent upon the rated current (I_n)

```
Inv.time ov.cur.
I start= 0.00*In
```

Inverse time-overcurrent: I-Start **1 to 3.00*In**

The lower tripping value for inverse time-overcurrent protection is defined by this parameter. If the monitored current (I) is below I_{Start}, the inverse time-overcurrent protection does not trip. I_p is used as the lower tripping value if I_{Start} is configured less than I_p.

Characteristics

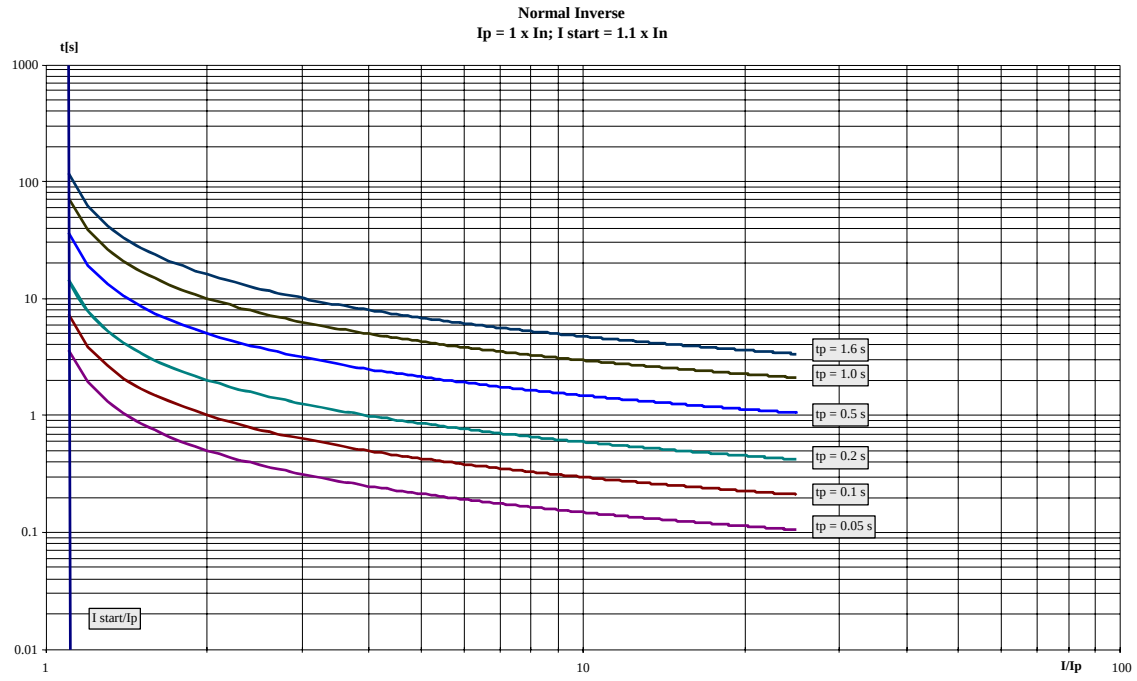


Figure 6-2: Inverse time-overcurrent - characteristic "normal inverse"

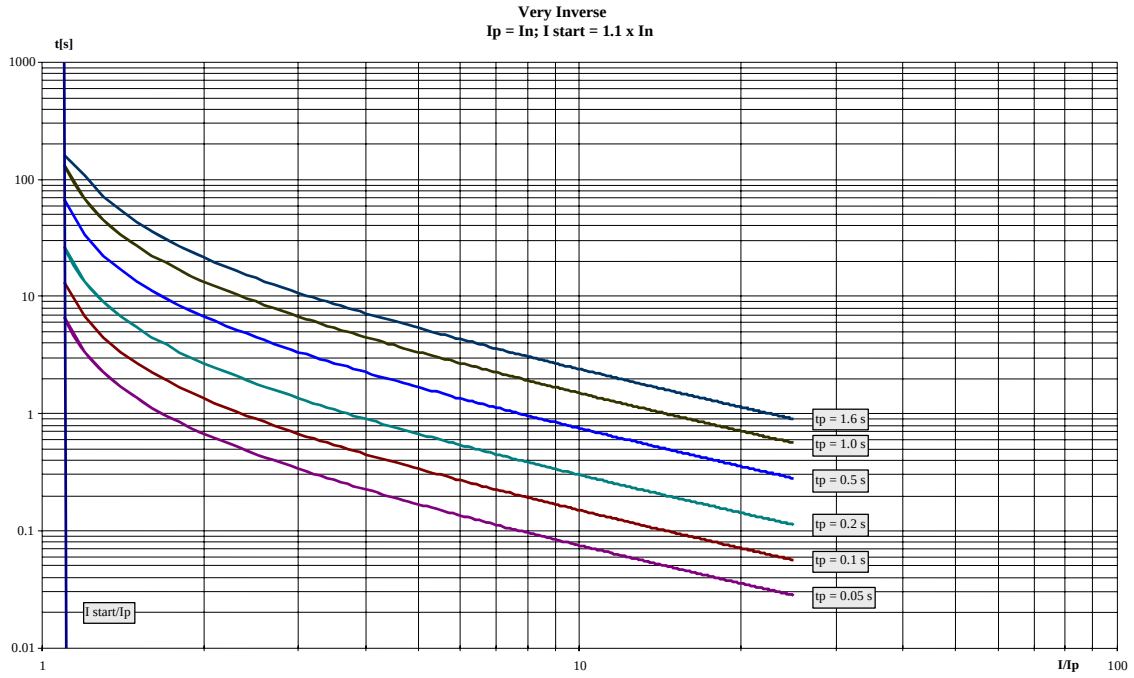


Figure 6-3: Inverse time-overcurrent - characteristic "very inverse"

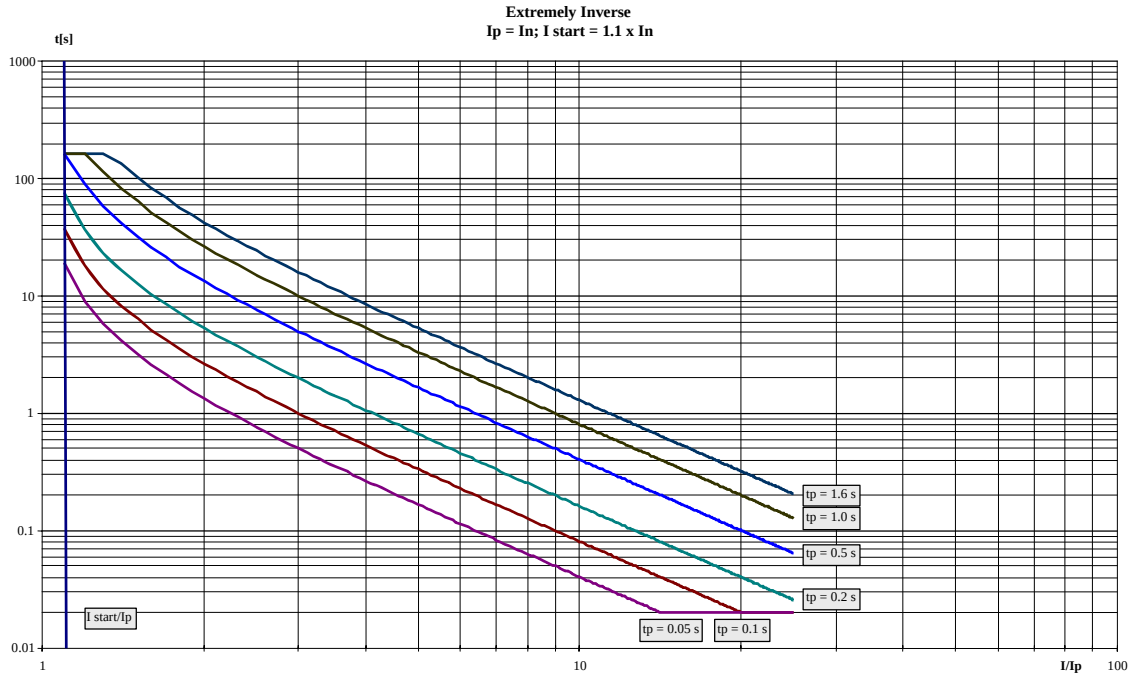


Figure 6-4: Inverse time-overcurrent - characteristic "extremely inverse"

Inverse Time-Overcurrent Monitoring with Voltage Restraint (Option IU)

NOTE

All percentage indications of the current are in relation to the rated current (see page 37).

Function: This function is recommended for a generator that must be monitored with droop excitation and precautions for short-circuit excitation (e.g. supplementary components) are not available. A short-circuit close to the terminal may be caused due to the low voltage excitation cannot be maintained. As a result, the unit cannot maintain power in order to initiate a voltage independent overcurrent delay. The voltage restraint functionality reduces the overcurrent threshold proportionally with the monitored voltage. The reduction of the inverse time threshold occurs according to Figure 6-5.

Current L1: corresponds to voltage L1-L2
Current L2: corresponds to voltage L2-L3
Current L3: corresponds to voltage L3-L1

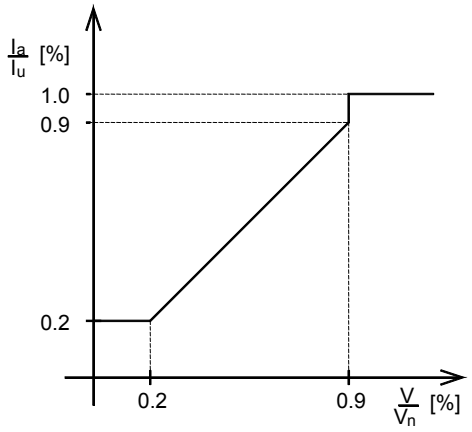


Figure 6-5: Characteristic of the inverse time-overcurrent monitoring with voltage restraint (knee curve setting 20 %)

Data meaning:

I_a	adjusted threshold value
I_u	setting value
V_n	rated voltage
V	monitored voltage

```
Inv.time ov.cur.
V-restr.     ON
```

Inverse time-overcurrent monitoring with voltage restraint **ON/OFF**

ON .....Inverse time-overcurrent monitoring with voltage restraint is enabled. The subsequent screens of this function are displayed.
OFF .....Inverse time-overcurrent monitoring with voltage restraint is disabled. The subsequent screens of this function are not displayed.

```
Inv.time ov.curr
knee curve U>00%
```

Threshold inverse time-overcurrent with voltage restraint **10 to 90 %**

The threshold limit for the voltage is defined in this parameter. If the voltage falls below this limit value the overcurrent protection is deactivated.

Ground Fault Monitoring (Option IKN, IS)

Ground fault monitoring for low-impedance or solidly grounded systems.

Function: The ground fault monitoring can be configured for two threshold limits. The third harmonics single-phase components may result in false currents being monitored on the grounding circuit. A digital anti-aliasing filter is utilized to separate theses harmonics and prevent inaccurate values caused by harmonics from being displayed. If the actual sine wave of the ground current exceeds the configured threshold, an alarm message is displayed. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

Acquiring the measured value:

- Ground fault measuring (Option IKN)
  The ground current is generally measured via a single-phase current transformer (../1A) at the neutral point of the wye system, current transformers connected in Holmgreen, or with a cable-type transformer.

- Ground fault, calculated (Option IS)
  The ground current is measured by calculating the vectorial sum of the three monitored phase currents. The current transformer should be sized so that the configured ground current threshold is at least 10% of the transformer's current rating to ensure proper operation.

```
Earth current
monitoring   ON
```

Ground fault monitoring **ON/OFF**

ON..... Ground fault monitoring is enabled. The subsequent screens of this function are displayed.
OFF..... Ground fault monitoring is disabled. The subsequent screens of this function are not displayed.

```
Earth current 1
Response =  000%
```

Threshold ground fault, level 1 **10 to 300 %**

Ground fault current (level 1) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 1
Delay    00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 1) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current 2
Response =  000%
```

Threshold ground fault, level 2 **10 to 300 %**

Ground fault current (level 2) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 2
Delay    00,00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 2) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current
Hysteresis  000%
```

Hysteresis for the ground fault monitoring, level 1+2 **1 to 300 %**

In order to prevent system fluctuations from continually initiating ground fault current alarms (levels 1 & 2), a lower release point is defined here. If the control monitors the current above the permissible limit, the current must drop below that threshold and the current level defined here.
Example: If a 1000A system has a ground fault current limit 1 of 5% (50A) and a hysteresis of 2% (20A), the monitored current for a ground fault current alarm must drop below 20A to reset the alarm.

Non-Direct. Ground-Fault Monit. via Displacement Volt. (Option IV)

The unit may be used to monitor for earth faults in the stator winding of three-phase motors drawing current from the mains via a unit-connected transformer. If a ground current fault is detected, the control senses the current phase shift, providing about a 95% protection of the windings rating.

First tripping level for the displacement voltage

Function: "Measurement of the displacement voltage (level 1)"
The displacement voltage is usually measured via the open delta winding (e-n-winding) of a potential transformer or via a zero sequence transformer in the star point of the machine. If potential transformers with secondary voltages greater than 100V (e.g. 240 V, 500 V), the voltage at the earth fault input terminal must be reduced to a voltage level less than 100V through the use of a voltage divider. The single-phase third harmonics components may result in false currents being monitored on the grounding circuit. A digital anti-aliasing filter is utilized to separate theses harmonics and prevent inaccurate values caused by harmonics from being displayed. If the actual sine wave of the ground current exceeds the configured threshold, the alarm message "**E.fault Ve**" is displayed. This message cannot be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Earth fault
monitoring  ON
```

Non-directional ground fault monitoring **ON/OFF**

ON.....The non-directional ground fault monitoring is enabled. The subsequent screens of this function are displayed.
OFF.....The non-directional ground fault monitoring is disabled. The subsequent screens of this function are not displayed.

```
Earth fault Ve>
Response v. 000%
```

Threshold displacement voltage, level 1 **3 to 100 %**

The displacement voltage threshold (level 1) is defined by this parameter. The percentage configured here refers to the configured rated voltage of the potential transformer secondary (generally 100 V). If this limit is reached or exceeded, the unit outputs the message "**E.fault Ve**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth fault Ve>
Delay     00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate a ground fault alarm, the displacement voltage threshold (level 1) must be exceeded and remain above the configured threshold without interruption for at least the period of time specified in this screen.

Second tripping level for the displacement voltage

Function: "Measurement of the displacement voltage (level 2)/disconnect impedance reactor"
Isolated or compensated distribution systems may use an impedance reactor to increase the resistance to earth. This type of equipment generally isn't designed for continuous rated current at full displacement. Therefore, this equipment must be disabled when the displacement voltage exceeds a set value. **It must be taken into consideration that the impedance reactor may only be disabled after the earth fault alarm has been initiated.** This requires a longer delay time be configured if the impedance reactor must be turned off. Additionally the displacement voltage threshold (level 2) must be configured higher than the level 1 threshold. When the displacement voltage threshold (level 2) has been exceeded, the alarm message "**Earth Ve>>**" is displayed. This message cannot be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Earth fault Ve>>
Response v. 000%
```

Threshold displacement voltage, level 2 **3 to 100 %**

The displacement voltage threshold (level 2) is defined by this parameter. The percentage configured here refers to the configured rated voltage of the potential transformer secondary (generally 100 V). If this limit is reached or exceeded, the unit outputs the message "**Earth Ve>>**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth fault Ve>>
Delay    =00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate a ground fault alarm, the displacement voltage threshold (level 2) must be exceeded and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Release delay
Earth f.v.00.00s
```

Release delay for non-directional ground fault **0.02 to 99.98 s**

In order to prevent system fluctuations from continually initiating non-directional ground fault current alarms (levels 1 & 2), the monitored displacement voltage must remain below the threshold limit for the time configured here. The level 1 alarm will auto-acknowledge only if the parameter "Auto-clearing Relays" is configured as "ON". The level 2 alarm will always auto-acknowledge.

Ground-Fault Monitoring, Measured (Option IK)

Measured ground fault monitoring with isolated or balanced mains.

The line-to-ground current is usually measured via a cable-type transformer or current transformers in Holmgreen. Ground faults result in comparatively small ground currents at the location of the fault. The measuring input is specially designed for these small ground currents. The measuring input is limited to a maximum of 35mA. The ground fault current input is thermally designed to withstand the CT secondary rated current. All measurements are galvanically isolated. If a ground fault does occur, the control unit issues an alarm message. This message can be suppressed with the discrete input "Blocking of protective functions / remote acknowledgement".

```
Earth current
monitoring   ON
```

Ground fault monitoring, measured **ON/OFF**

ON.....Ground fault monitoring (measured) is enabled. The subsequent screens of this function are displayed.
OFF.....Ground fault monitoring (measured) is disabled. The subsequent screens of this function are not displayed.

```
Earth current 1
Response =  000%
```

Threshold ground fault, measured, level 1 **0.05 to 3.50 %**

Ground fault current (level 1) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.1**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 1
Delay    00.00s
```

Pickup delay, level 1 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 1) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current 2
Response =  000%
```

Threshold ground fault, measured, level 2 **0.05 to 3.50 %**

Ground fault current (level 2) is defined by this parameter. The percentage configured here refers to the configured rated current (refer to page 37). If this limit is reached or exceeded, the unit outputs the message "**Earthcur.2**". If a relay was assigned to this function in the relay manager, that relay will be energized.

```
Earth current 2
Delay    00.00s
```

Pickup delay, level 2 **0.02 to 99.98 s**

In order to initiate a ground fault current (level 2) alarm, the measured ground fault current must exceed and remain above the configured threshold without interruption for at least the period of time specified in this screen.

```
Earth current
Hysteresis 0.00%
```

Hysteresis for the ground fault monitoring, measured, levels 1+2 **0.00 to 3.50 %**

In order to prevent system fluctuations from continually initiating ground fault current alarms (levels 1 & 2), a lower release point is defined here. If the control monitors the current above the permissible limit, the current must drop below that threshold and the current level defined here.
Example: If a 1A CT secondary has a ground fault current limit 1 of 2% (2mA) and a hysteresis of 1.5% (15mA), the monitored current for a ground fault current alarm must drop below 15mA to reset the alarm.

Directional Ground Fault Monitoring (Option IV, IK)

Directional ground fault monitoring is used in isolated and compensated networks.

Functional Description

Function: "Ground fault within the protection area"
The Options IV, IK enable to perform a direction-dependent ground fault monitoring. A selective monitoring of several generators, which feed one busbar without block transformers, is possible.

The following parameters must be configured to **ON** to perform directional ground fault monitoring:

- Earth fault monitoring
- Earth current monitoring

If the displacement voltage reaches or exceeds the threshold value Ve, the earth fault monitoring will be enabled after expiry of the configured delay time. If the alarm message "Warning earth f." has been configured to a relay, this will be energized. No display message appears. This relay may be used for example to generate a "Ground fault outside the protection area" message together with another relay or to connect a load device.

Function without direction check ("Earth fault Ie restricted" configured to OFF)

If the measured ground current reaches or exceeds the "Earth fault 1" or "Earth fault 2" limit, the "E.fault Ve" message will be issued after expiry of the configured delay time. The current direction will not be taken into account. This message may be suppressed with the discrete input "Blocking of protective functions / Remote acknowledgement".

Function with direction check ("Earth fault Ie restricted" configured to ON)

If the measured ground current reaches or exceeds the "Earth fault 1" or "Earth fault 2" limit and the unit detects a ground fault within the protection area by the angle between current and voltage, the "E.fault Ve" message will be issued after expiry of the configured delay time. Therefore, the current direction will be taken into account in the way configured in the following settings. If the unit detects a ground fault outside the protection area, no alarm will be issued. This message may be suppressed with the discrete input "Blocking of protective functions / Remote acknowledgement".

NOTE

Ground fault protection at start-up.

If the discrete input "Blocking of protective functions / Remote acknowledgement" is energized with open GCB, ground current monitoring and direction detection will be disabled. The "Earfh fault Ve" monitoring operates in its basic functionality. This enables to detect a ground fault when starting the engine already by detecting the occurring displacement voltage and issuing an alarm.

```
Earth fault Ie
restricted    ON
```

Directional ground fault monitoring **ON/OFF**

ON..... The direction of the ground current is monitored to ensure that it is proportional to the measured displacement voltage. A fault condition is not recognized if the direction element determines that the ground fault is external.

OFF..... Directional ground fault current monitoring is not enabled and the following screens are not displayed.

```
Earth fault Ie
Evaluation   sin
```

Analysis of the reactive (sin) or active component (cos) **sin/cos**

sin..... The direction of current is defined by the measurement of the reactive current. This setting should be selected if directional ground overcurrent monitoring is being performed in an isolated system.

cos ..... The direction of current is defined by the measurement of the inductive current. This setting should be selected if directional ground overcurrent monitoring is being performed in a compensated system.

```
Earth fault Ie
Angle adj.  000°
```

Angle correction of the ground current **-180 to 0 to 180°**

To monitor specific systems, the phase angle monitoring can be tuned. This permits threshold limits to be adapted to the plant without having to desensitize ground fault current monitoring. It should be noted that the analysis mode changes automatically to adjustments greater than 90° or less than -90°. If the analysis mode "cos" is configured, the monitored phase angle is adjusted by 90° in relationship to a "sin" measurement with a phase angle correction of 0°.

```
Earth fault Ie
Block range  00°
```

Angle blocking zone for ground current logging **0 to 10°**

Compensated systems generally only have very slight ground fault currents. The magnitude of the ground fault current at the fault location is approximately 5% of the capacitive fault current in an isolated system. The phase shift of the ground fault current could be influenced by the potential or current transformers causing an incorrect fault condition to be recognized. Therefore phase angles around 90° can be ignored in the range of +/-10°.

Relay Configuration

NOTE

Clearing of faults and fault messages from the control unit will depend on the parameters "External clearing", "Auto-clearing Relays", and "Auto-clearing Display". These three parameters will influence the other depending on how each is configured. This is explained in the following text.

```
External
Clearing     ON
```

External acknowledgement of the relays via the discrete input "Blocking of protective functions / remote acknowledgement".

Acknowledgement via the discrete input **ON/OFF**

"**Auto-clearing Relays**" configured "**OFF**" (refer to "Auto Acknowledgement of the Relay" on page 52):

OFF .....Alarms that cannot be blocked with discrete input "Blocking of protective functions / remote acknowledgement" will not be reset when the fault condition is no longer present. Pressing the "Clear" button resets the relays.
ON .....All alarms are reset when the discrete input "Blocking of protective functions / remote acknowledgement" (terminals 5/6) is energized. Alarms which cannot be blocked with the discrete input "Blocking of protective functions / remote acknowledgement" are only reset after the fault condition is no longer present.

"**Auto-clearing Relays**" configured "**ON**" (refer to "Auto Acknowledgement of the Relay" on page 52):

OFF .....Pressing the "Clear" button resets the displayed fault messages.
ON .....All displayed fault messages are reset when the discrete input "Blocking of protective functions / remote acknowledgement" (terminals 5/6) is energized. Alarms which cannot be blocked with the discrete input "Blocking of protective functions / remote acknowledgement" are only reset after the fault condition is no longer present.

Auto Acknowledgement of the Relays

```
Auto-clearing
Relays       ON
```

Relay auto acknowledgment **ON/OFF**

ON .....Automatic clearing of the relays is enabled. The relays are automatically reset when the fault condition is no longer detected. The alarm message in the display is cleared according to how the parameter "**Auto-clearing Display**" is configured.
OFF .....Automatic clearing of the relays is disabled. Pressing the "Clear" button resets the relays.

The alarm message in the display is cleared according to how the parameter "**Auto-clearing Display**" is configured. The subsequent screens of this function are not indicated.

NOTE

The subsequent screens are only visible if the parameter "Auto-clearing Relays" and the corresponding protective function are enabled and the control unit is equipped with the protective functionality.

```
Release delay
xxxxxxxxx 00.00s
```

Release delay of the relays **0.02 to 99.98 s**

The individual relays will reset if "Auto-clearing relays" has been enabled and the monitored values have returned to the permissible limits plus / minus the hysteresis (depending on monitoring) without interruption for the time specified in this parameter. If the monitored value exceeds / falls below the threshold limit, the delay timer re-initiates its countdown. The following protective functions may have reset delays configured.

Monitoring for ...		Display indication instead of xxxxxxxx	Remark
Independent time-overcurrent monitoring	Option IZ	Overcurr.	Time overcurrent 1, 2, and 3
Inverse time-overcurrent	Option IU	Curr.-Inv	
Inverse time-overcurrent with voltage restraint	Option IU	Curr.-Inv	
Ground fault	Option IK/IKN/IS	Earth F.	Ground current 1 and 2
Non-directional ground fault via displacement volt. Ve	Option IV	Earth F.v.	

Table 6-1: Release delay of the relays

Auto Acknowledgement of Messages

```
Auto-clearing
Display      ON
```

Messages auto acknowledgment **ON/OFF**

ON..... After the alarm condition is no longer detected, the message on the display is deleted.

OFF..... The alarm message remains in the display after the fault condition is no longer detected until manually cleared. The subsequent screen of this function is not displayed.

NOTE

The subsequent parameter "Clearing display after " is not visible if "Auto-clearing Relays" is configured to "OFF".

```
Clearing display
       after 00s
```

Clear displayed message delay **1 to 99 s**

Alarm messages, which have been enabled, will be acknowledged after this configured delay time expires. This delay will initiate once the measure value exceeds/falls below the threshold limit +/- the hysteresis

Changing the Relay Assignment (Relay Manager; Standard / Option R)

```
Change relay-
allocation?  YES
```

Change relay assignment? **YES/NO**

This parameter permits the user to change how the relay outputs are configured. Refer to the list of parameters.

YES .....The relay assignments can be configured and the user may define the relay functionality and assignments. The subsequent screens are displayed.

NO .....The relays are configured with the factory default settings. The subsequent screens are not displayed.

NOTE

All relay outputs are configured the same. The following is an example showing relays 1 through 3. Depending on the model purchased, the unit may have up to 7 configurable relays. The Option R enables to use 5 additional relays.

Example: Relay 1 to 3

```
Funct. relay 123
(R=releases) RRR
```

Function of the relays 1, 2, and 3 **E/R**

The individual relays may be configured as either E=Energizes (Normally Open contacts) or R=Releases (Normally Closed contacts).

E .....The relay is configured as normally open (N.O.) contacts. The relay will energize only if the assigned monitoring function has tripped.

R .....The relay is configured as normally closed (N.C.) contacts. The relay is always energized and will only de-energize (release) if the assigned monitoring function has tripped.

NOTE Relay 1 is configured as R (release/N.C.) and cannot be modified.

NOTE

The following screen(s) will only be displayed if the unit is equipped with the corresponding protective function(s), the protective function is enabled, and the parameter "Change relay allocation" is enabled.

```
xxxxxxxxxxxxxxx
to relay    0000
```

Output of the protective units to the relays **0 to 4/8**

Each digit in this parameter is used to assign one relay to a protective function. Up to four relay outputs may be assigned to a protective function. The control may be configured as follows:

0..... If the protective function is not assigned to a relay, a "0" must be configured in the display. None of the relay outputs will energize/de-energize when the corresponding protective function trips if all four relay assignments are configured with a "0". A message for the protective function will still be visible in the unit display.

1/2/3 ..... Relay 1 (terminals 9/10), relay 2 (terminals 11/12/13), and/or relay 3 (terminals 14/15/16) are available for assignment to protective function on all units.

4/5/6/7/8 ..... Relay 4 (terminals 19/20/21), relay 5 (terminals 22/23/24), relay 6 (terminals 25/26/27), relay 7 (terminals 28/29/30), and/or relay 8 (terminals 31/32) are available for assignment to protective function if the unit is equipped with Option R.

Example..... A unit with Option R has a protective function that is required to output a signal to relays 2,4, and 7. That protective function relay assignment should be configured as 2470. The sequence of the numbers has no significance in the functionality or operations.

A relay output may be assigned to more than one protective function. This will cause the relay to issue a signal when any of the configured protective functions trip. If a relay should only issue a signal when a specific protective function trips, then the relay must not be assigned to any other protective function.

Monitoring of ... output to relay		Indication on display instead of xxxxxxxxxx
Independent time-overcurrent, level 1	Option IZ/IS	**Overcurrent1**
Independent time-overcurrent, level 2	Option IZ/IS	**Overcurrent2**
Independent time-overcurrent, level 3	Option IZ/IS	**Overcurrent3**
Inverse time overcurrent	Option IU	**Inv.time ov.curr**
Inverse time overcurrent with voltage restraint	Option IU	**Inv.time ov.curr**
Ground fault, level 1	Option IK/IKN	**Earth Fault 1**
Ground fault, level 2	Option IK/IKN	**Earth Fault 2**
Non-directional ground fault via displacement voltage, level 1	Option IV	**Earth Fault Ve>**
Non-directional ground fault via displacement voltage, level 2	Option IV	**Earth Fault Ve>>**
Ground fault	Option IV/IK	**Warning earth F.**
Centralized alarm		**Collect Response**

Table 6-2: Protective device output to relay

NOTE

The "ready for operation" function is always assigned to relay 1. However, other protective functions may also be assigned to relay 1 additionally. Relay 1 is always configured as Normally Closed (break contact) and will de-energize if the unit is not ready for operation.

Analog Outputs (Options A1/2/3/4/6/8)

NOTE

The common use of the analog outputs, the interfaces and the discrete inputs depends on their respective combinations. Please pay attention to the combinations possible as described in the introduction.

CAUTION

The function of the analog outputs is restricted during configuration via the side connector (version 3.xxx). The parameter "Direct parameter." must be set to "NO" in order to make all analog outputs available (refer to "Direct Configuration (from Version 3.0xx)" on page 36).

It is possible to configure a linear measuring range for each analog output and assign it to a specific measured value (refer to Table 6-3). The -20/0/4 to 20 mA analog outputs may be configured as a -20 to 20 mA, 0 to 20 mA, or 4 to 20 mA output. The -10/0 to 10 V analog outputs may be configured as a -10 to +10 V or 0 to +10 V output. The user may define the upper and lower limits of the analog input measuring range. Text may be assigned to the input as well.

Value	Lower and upper setting value	
	0 V, -10 V 0 mA, 4 mA, -20 mA	10 V, 20 mA
V L1-N[1]	0 to 65,000 V	
V L2-N[1]	0 to 65,000 V	
V L3-N[1]	0 to 65,000 V	
V L-N mean value[1]	0 to 65,000 V	
V L-N max. value[1]	0 to 65,000 V	
V L-N min value[1]	0 to 65,000 V	
V L1-L2[1]	0 to 65,000 V	
V L2-L3[1]	0 to 65,000 V	
V L3-L1[1]	0 to 65,000 V	
V L-L mean value[1]	0 to 65,000 V	
V L-L max. value[1]	0 to 65,000 V	
V L-L min. value[1]	0 to 65,000 V	
Frequency[1]	40.00 to 80.00 Hz	
I L1	0 to 9,999 A	
I L2	0 to 9,999 A	
I L3	0 to 9,999 A	
I 1-3 mean value	0 to 9,999 A	
I 1-3 max. value	0 to 9,999 A	
I 1-3 min. value	0 to 9,999 A	
I L1 (+/-)[1,2]	-9,999 to +9,999 A	
I L2 (+/-)[1,2]	-9,999 to +9,999 A	
I L3 (+/-)[1,2]	-9,999 to +9,999 A	
I 1-3 (+/-) mean[1,2]	-9,999 to +9,999 A	
I 1-3 (+/-)max[1,2]	-9,999 to +9,999 A	
I 1-3 (+/-)min[1,2]	-9,999 to +9,999 A	

[1].... Only if the Option IU or IR is included.
[2].... The sign of the current values is defined by the polarity of the active component.

Table 6-3: Analog outputs, table of values

Example: analog output 2 (-10/0 to 10 V: terminals 50/52, -20/0/4 to 20 mA: terminals 52/53)
Output of the phase-to-phase voltage V_{L1-L2}:

20 mA output

```
Analog output 2
      0 .. 20 mA
```

10 V output

```
Analog output 2
      0 .. 10 V
```

Output range of the analog output 2 — **(20 mA) –20..+20 / 0..20 / 4..20 mA / OFF**
(10 V) –10..+10 / 0..10 V / OFF

The only variable that may be changed for this parameter is the lower value for this analog output. The upper limit is always +20 mA.
-20..20mA .... -20 mA is the configured low limit for the analog output
0..20mA ..... 0 mA is the configured low limit for the analog output
4..20mA ..... 4 mA is the configured low limit for the analog output
OFF..... The analog output is not enabled. The subsequent screens of this function are not displayed.

The only variable that may be changed for this parameter is the lower value for this analog output. The upper limit is always +10 V.
-10..+10 V .... -10 V is the configured low limit for the analog output
0..10 V..... 0 V is the configured low limit for the analog output
OFF..... The analog output is not enabled. The subsequent screens of this function are not displayed.

```
Analog output 2
----------------
```

Output value of the analog output 2 — **see Table 6-3**

The parameter that is to be assigned to the output is selected here (refer to Table 6-3).

```
Analog output
  0mA =   00000V
```

Example for 20 mA-output

Scaling of the lower output value — **see Table 6-3**

Defines the lower limit of the output.

```
Analog output
20mA =   00000V
```

Example for 20 mA-output

Scaling of the upper output value — **see Table 6-3**

Defines the upper limit of the output.

Interface (Options SU/SB)

CAUTION

The function of the interface is restricted during the configuration via the side connector (version 3.xxx). The parameter "Direct parametr." must be configured "NO" to make the interface available (refer to "Direct Configuration (from Version 3.0xx)" on page 36).

NOTE

These screens and all related screens are only displayed if the particular communication option is included on the control unit. If the individual communication protocol is not included, the related screens will not be displayed.

NOTE

A description of the communication protocols may be found in Appendix D of this manual.

Screens for Protocol DK3964 (Option SU)

```
Data block
RK512        000
```

Data block RK512 **0 to 255**

Data block address in receiver (e. g. PLC).

```
Data word RK512
          000
```

Data word RK512 **0 to 255**

Data word address in receiver (e.. g. PLC).

Screens for Protocol Profibus DP Slave (Option SU)

```
Device number
Profibus     000
```

Device number profi-bus DP slave **0 to 126**

Device number for the profi-bus DP slave.

Screens for Protocol Modbus RTU Slave (Option SU/SB)

```
Device number
MOD-Bus      000
```

Device number Modbus RTU Slave **1 to 255**

Device number for the Modbus RTU Slave.

```
Baudrate
          0000
```

Baud rate Modbus RTU Slave **1,200 / 2,400 / 4,800 / 9,600 / 19,200 Baud**

The baud rate of the Modbus RTU Slave is defined here.

```
Parity
          none
```

Parity Modbus RTU Slave **none / even / odd**

The parity of the Modbus RTU Slave is defined here.

```
Stopbits
          one
```

Stop bits Modbus RTU Slave **one / two**

The number of stop bits of the Modbus RTU Slave is defined here.

```
Delay to send
MOD-Bus   00.0ms
```

Waiting time transmission after read request **0.2 to 50.0 ms**

After the read request by the master, the minimum waiting time before transmitting the answer is configured here. This allows the controller to adjust the response time to the master so that it can process the answer.

Screens for Protocol CAN Bus (Options SU/SB)

NOTE

Please note that IDs must not be allocated twice. This applies to all units linked to the bus system. Moreover, all IDs adjusted at the unit must be set to different values.

Procedure for transmission-IDs: The same "Basic-ID Transmission" is allocated to all units existing within the bus system. This allows a grouping of the various types of information. (Example: The same "Basic-ID Transmission" = 800 is allocated to all units. By means of the different unit numbers, the individual IDs are then allocated; unit number 1: ID = 801; unit number 2: ID = 802; etc.)

```
Device number
CAN-Bus      0
```

Device number CAN-bus **1 to 8**

The device number at CAN-bus is entered here. The device number affects the calculation of the transmitting- and controlling IDs.

```
Baudrate
          0000
```

Baudrate CAN-Bus **125/250/500kBaud**

Setting the baudrate.

```
Base-ID (send)
             0000
```

Basic - ID Transmission **0 to 2015**

The ID, from which the device is transmitting its operating data, is calculated from the Basic-ID Transmission + Device Number CAN-Bus.

```
Base-ID (remote)
             0000
```

Basic - ID control **0 to 2015**

The ID, at which the device receives control data, is calculated from the Basic-ID-Control + Device Number CAN-Bus.

```
ID (parametriz.)
             0000
```

ID for remote parameterization **0 to 2015**

Here the ID is entered on which the unit receives parameterization data. If the remote parameterization occurs via a system GW 4, these ID's must always be set to the value 831.

General Screens for All Interfaces (Option SB)

```
Serial control
              ON
```

Control via interface **ON/OFF**

ON .....Control via the serial interface is enabled and control orders received via the interface are processed.
OFF .....Control via the serial interface is disabled and control orders received via the interface are ignored.

```
Serial interface
Monitoring  ON
```

Interface monitoring **ON/OFF**

ON .....The interface monitoring is enabled. The control expects to receive bits 2 and 3 to be written to "00" in the control word by the master control within 15 seconds after receiving the last message. If these bits are not read within the prescribed time, and unsuccessful data exchange is detected, and the alarm message "**Interface**" is issued.
OFF .....The interface monitoring is disabled.

```
Interface fault
to relay    0000
```

Relay assignment for interface error **0 to 3 / 0 to 8**

Relays may be configured to energize when an interface fault is detected. The desired relays that to energize are configured here. The relays will only energize if the parameter "**Serial interface monitoring**" is configured as "**ON**".

```
Inhibit via
Interface    ON
```

Blocking via the interface **ON/OFF**

ON .....The protective functions messages (i.e. underfrequency) may be suppress via the interface. This operates in the same manner as terminals 5/6 "Blocking of protective functions / remote acknowledgement".
OFF .....The protective functions messages (i.e. underfrequency) cannot be suppress via the interface.

Chapter 7.
Commissioning

DANGER - HIGH VOLTAGE

When commissioning the control, please observe all safety rules that apply to the handling of live equipment. Ensure that you know how to provide first aid in the event of an uncontrolled release of energy and that you know where the first aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

L I F E T H R E A T E N I N G

CAUTION

Only a qualified technician may commission unit. The "EMERGENCY-STOP" function must be operational prior to commissioning of the system, and must not depend on the unit for its operation.

CAUTION

Prior to commissioning ensure that all measuring devices are connected in correct phase sequence. The connect command for the unit circuit breaker must be disconnected at the unit circuit breaker. The field rotation must be monitored for proper rotation. Any absence of or incorrect connection of voltage measuring devices or other signals may lead to malfunctions and damage the unit, the engine, and/or components connected to the unit!

Procedure

1. After wiring the unit and ensuring all voltage-measuring devices are phased correctly, apply the control system voltage (i.e. 24 Vdc). The "Operation" LED will illuminate.

2. By simultaneously pressing the two push buttons "Digit↑" and "Cursor→", the configuration mode is accessed. After entering the access code number, the unit may be configured according to the application requirements (see the chapter regarding the parameters).

3. After applying the measured variables, the unit will display the measured values. These values should be confirmed with a calibrated measuring instrument.

4. Now, proceed as follows to change the code level:

until version 1.9xx:

```
Coding
              ON
```

Sealing function

Enter: **"ON"** select and confirm using the "Select" button

```
Code  no. 000
Code?     ?????
```

Code input

Enter: Button "Select".

```
Incorrect entry
[Next: Select]
```

Incorrect input

Enter: Button "Select".

```
Code  no. 000
Break?       NO
```

Break seal

Enter: **"YES"** Select and confirm using "Select" button

```
Code  no. 000
New code: ?????
```

Enter new code

Enter: Enter new code number and confirm using "Select" button

from version 2.0xx:

```
Enter code
number      0000
```

Enter code number **0 to 9999**

On accessing the parameterization mode, a code number, which identifies the various users, is first requested. The indicated number XXXX is a random number (ZU) and is confirmed using the "Select" button. If the random number was confirmed without modification using "Select", the code level remains as it was. Two four-digit code numbers (0000 to 9999) exist for changing the code level and setting up new code words for the users. No assignment is required for the "third party" user level, as the user does not usually receive access to the parameterization level (protected via the code).

5. After the unit has been configured for the application, the configuration mode is exited by simultaneously pressing the "Digit↑" and "Cursor→" buttons.

Appendix A.
Dimensions

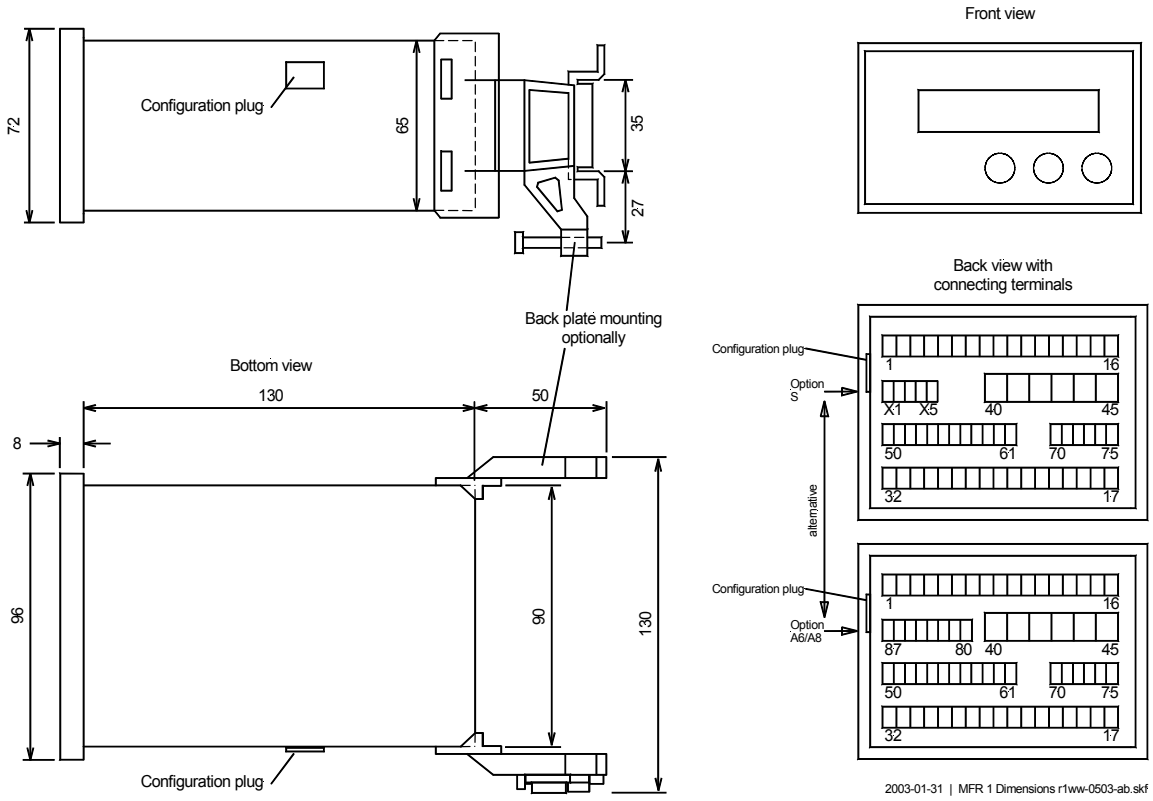
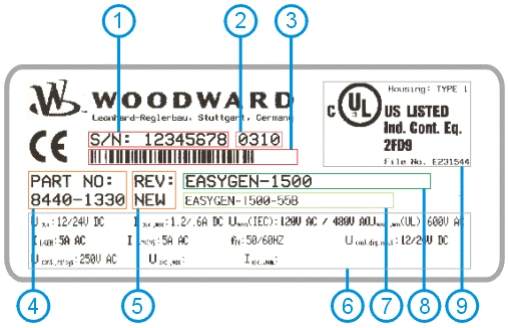


Figure 7-1: Dimensions

Appendix B.
Technical Data

Nameplate



1	S/N	Serial number (numerical)
2	S/N	Date of production (YYMM)
3	S/N	Serial number (Barcode)
4	P/N	Item number
5	REV	Item revision number
6	Details	Technical data
7	Type	Description (long)
8	Type	Description (short)
9	UL	UL sign

Measuring voltage

- Measuring voltage — Standard (V_{rated}) ⅄/Δ ..... 66/115 Vac
  Maximum value V_{ph-ph} max. (UL/cUL) ..... max. 150 Vac
  Rated voltage $V_{ph-ground}$ ..... 150 Vac
  Rated surge voltage ..... 2.5 kV
- Measuring frequency ..... 40.0 to 80.0 Hz
- Accuracy ..... Class 1
- Resistance ..... 0.1 %
- Linear measuring range ..... 1.3 × V_{rated}
- Input resistance ..... [1] 0.21 MΩ
- Maximum power consumption per path ..... 0.15 W

Measuring current — isolated

- Measuring current I_{rated} ..... [1] ../1 A
  [5] ../5 A
- Accuracy ..... Class 1
- Linear measuring range ..... 3.0 × I_{rated}
- Power consumption ..... < 0.15 VA
- Rated short-time current (1 s) ..... [1] 100.0 × I_{rated}
  [5] 20.0 × I_{rated}

Ambient variables

- Power supply ..... 24 Vdc (18 to 30 Vdc)
- Intrinsic consumption ..... max. 12 W
- Ambient temperature — Storage ..... -40 to 85 °C / -40 to 185 °F
  Operational ..... -20 to 70 °C / -4 to 158 °F
- Ambient humidity ..... 95 %, not condensing
- Maximum altitude ..... 2000 m
- Degree of pollution 2

Discrete inputs — isolated

- Input range ($V_{Cont, discrete input}$) ..... Rated voltage 18 to 250 Vac/dc
- Input resistance ..... approx. 68 kΩ

Relay outputs ----------potential free

- Contact material ..... AgCdO
- General purpose (GP) ($V_{Cont, relay output}$)

AC ..... 2.00 Aac@250 Vac
DC .....2.00 Adc@24 Vdc
0.36 Adc@125 Vdc
0.18 Adc@250 Vdc

- Pilot duty (PD) ($V_{Cont, relay output}$)

AC .....
DC .....1.00 Adc@24 Vdc
0.22 Adc@125 Vdc
0.10 Adc@250 Vdc

Analog outputs ----------isolated

- At rated value .....freely scaleable
- Insulation voltage ..... 1,500 Vdc
- Resolution PWM .....12 Bit
- -20/0/4 to +20 mA output ..... Maximum load 500 Ω
- -10/0 to 10 Vdc outpu.....Internal resistance 100 Ω

Interface ----------isolated

- Insulation voltage .....dependent on model: 500 to 3,000 Vdc
- Version .....variable

Housing ----------

- Type..... APRANORM DIN 43 700
- Dimensions (W × H × D) ..... 96 × 72 × 130 mm
- Front cutout (W × H).....91 [+1.0] × 67 [+0.7] mm

- Wiring..... Screw-type terminals depending on connector 1.5 mm², 2.5 mm², or 4 mm²
- Recommended tightening torque.....[1.5 mm² / 2.5 mm²] 0.5 Nm, [4 mm²] 0.6 Nm
use 60/75 °C copper wire only
use class 1 wire only or equivalent
- Weight .....approx. 800 g

Protection----------

- Protection system..... IP42 from front at professional mounting
IP54 from front with gasket (gasket: P/N 8923-1036)
IP21 from back
- Front foil.....insulating surface
- EMC test (CE) .....tested according to applicable EN guidelines
- Listings .....CE marking; UL listing for ordinary locations
UL/cUL listed, Ordinary Locations, File No.: E231544
(no UL/cUL listing for units equipped with Option N!)
- Marine-Approval ..... GL

Appendix C.
Measured Quantities and Accuracy

Measuring value	Display/range	Accuracy	Note
Voltage			
V_{L1}, V_{L2}, V_{L3}, V_{L12}, V_{L23}, V_{L31}	0 to 520 V/0 to 65 kV	1 %	Accuracy depending on the configured transformer ratio
Current			
I_{L1}, I_{L2}, I_{L3}	0 to 9,999 A	1 %	-

Reference conditions: The data apply to the following reference conditions:

- Input voltage = sinusoidal rated voltage
- Input current = sinusoidal rated current
- Power supply = rated voltage ± 2 %
- Power factor cos φ = 1
- Ambient temperature 23 °C ± 2 K
- Warm-up period = 20 minutes.

Appendix D.
Interface Telegram

Communication Interface Addresses

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
00 01	**1** (02, 03)	**MUX=1, 1**	**0**	Telegram header	"302"	Telegram type
02 03	**2** (04, 05)	**MUX=1, 2**	**1**	Voltage L12	V	
04 05	**3** (06, 07)	**MUX=1, 3**	**2**	Voltage L23	V	
06 07	**4** (08, 09)	**MUX=2, 1**	**3**	Voltage L31	V	
08 09	**5** (10, 11)	**MUX=2, 2**	**4**	Voltage L1N	V	
10 11	**6** (12, 13)	**MUX=2, 3**	**5**	Voltage L2N	V	
12 13	**7** (14, 15)	**MUX=3, 1**	**6**	Voltage L3N	V	
14 15	**8** (16, 17)	**MUX=3, 2**	**7**	Frequency L12	Hz × 100	
16 17	**9** (18, 19)	**MUX=3, 3**	**8**	Current L1	A	
18 19	**10** (20, 21)	**MUX=4, 1**	**9**	Current L2	A	
20 21	**11** (22, 23)	**MUX=4, 2**	**10**	Current L3	A	
22 23	**12** (24, 25)	**MUX=4, 3**	**11**	Power factor cosphi	dim.less × 100	
24 25	**13** (26, 27)	**MUX=5, 1**	**12**	Real power	kW	
26 27	**14** (28, 29)	**MUX=5, 2**	**13**	Reactive power	kvar	
28 29	**15** (30, 31)	**MUX=5, 3**	**14**	Busbar voltage L12	V	
30 31	**16** (32, 33)	**MUX=6, 1**	**15**	Busbar voltage L12	Hz × 100	
32	**17** (34)	**MUX=6, 2**	**16**	Exponent	dim.less	VGN
33	**17** (35)	**MUX=6, 2**	**16**		dim.less	IGN
34	**18** (36)	**MUX=6, 3**	**17**	Exponent	dim.less	PGN/QGN
35	**18** (37)	**MUX=6, 3**	**17**		dim.less	VSS
36 37	**19** (38, 39)	**MUX=7, 1**	**18**	Generator real energy	kWh	High Word
38 39	**20** (40, 41)	**MUX=7, 2**	**19**			Low Word
40 41	**21** (42, 43)	**MUX=7, 3**	**20**	Internal alarms 1	Bit 15 = 1 \ Bit 14 = 0 /	Overfrequency level 2
					Bit 13 = 1 \ Bit 12 = 0 /	Underfrequency level 2
					Bit 11 = 1 \ Bit 10 = 0 /	Overvoltage level 2
					Bit 9 = 1 \ Bit 8 = 0 /	Overvoltage level 2
					Bit 7 = 1 \ Bit 6 = 0 /	Unbalanced load
					Bit 5 = 1 \ Bit 4 = 0 /	Overcurrent level 1
					Bit 3 = 1 \ Bit 2 = 0 /	Overload
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Reverse/reduced power

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
42 43	**22** (44, 45)	**MUX=8, 1**	**21**	Internal alarms 2	Bit 15 = 1 \ Bit 14 = 0 /	Overfrequency level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Underfrequency level 1
					Bit 11 = 1 \ Bit 10 = 0 /	Overvoltage level 1
					Bit 9 = 1 \ Bit 8 = 0 /	Undervoltage level 1
					Bit 7 = 1 \ Bit 6 = 0 /	Overcurrent level 3
					Bit 5 = 1 \ Bit 4 = 0 /	df/dt alarm
					Bit 3 = 1 \ Bit 2 = 0 /	Asymmetry (voltage)
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Vector/phase jump
44 45	**23** (46, 47)	**MUX=8, 2**	**22**	Internal alarms 3	Bit 15 = 1 \ Bit 14 = 0 /	Power factor level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Power factor level 2
					Bit 11 = 1 \ Bit 10 = 0 /	Inductive reactive power
					Bit 9 = 1 \ Bit 8 = 0 /	Capacitive reactive power
					Bit 7 = 1 \ Bit 6 = 0 /	Positive real power surge
					Bit 5 = 1 \ Bit 4 = 0 /	Negative real power surge
					Bit 3 = 1 \ Bit 2 = 0 /	Overcurrent level 2
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Interface fault
46 47	**24** (48, 49)	**MUX=8, 3**	**23**	Internal alarms 4	Bit 15 = 1 \ Bit 14 = 0 /	Busbar : Overfrequency
					Bit 13 = 1 \ Bit 12 = 0 /	Busbar : Underfrequency
					Bit 11 = 1 \ Bit 10 = 0 /	Busbar : Overvoltage
					Bit 9 = 1 \ Bit 8 = 0 /	Busbar : Undervoltage
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Internal
					Bit 3 = 1 \ Bit 2 = 0 /	Internal
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Internal

Number				Content (words)	Unit	Remark
3964	Modbus	CAN bus	Profibus			
48 49	**25** (50, 51)	**MUX=9, 1**	**24**	Internal alarms 5	Bit 15 = 1 \ Bit 14 = 0 /	Internal
					Bit 13 = 1 \ Bit 12 = 0 /	Internal
					Bit 11 = 1 \ Bit 10 = 0 /	Internal
					Bit 9 = 1 \ Bit 8 = 0 /	Internal
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Internal
					Bit 3 = 1 \ Bit 2 = 0 /	Zero voltage
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Power level reached
50 51	**26** (52, 53)	**MUX=9, 2**	**25**	Internal alarms 6	Bit 15 = 1 \ Bit 14 = 0 /	Ground fault Ue, level 1
					Bit 13 = 1 \ Bit 12 = 0 /	Internal
					Bit 11 = 1 \ Bit 10 = 0 /	Internal
					Bit 9 = 1 \ Bit 8 = 0 /	Internal
					Bit 7 = 1 \ Bit 6 = 0 /	Internal
					Bit 5 = 1 \ Bit 4 = 0 /	Ground fault Ue, level 2
					Bit 3 = 1 \ Bit 2 = 0 /	Internal
				Note (example bit 15/14): 0/1 = alarm not triggered 1/0 = alarm triggered	Bit 1 = 1 \ Bit 0 = 0 /	Internal

NOTE

Watchdog functions, which are not available, are transmitted with "01" (watchdog functions O.K.). Values which are not measured are transmitted with "0".

Description of the Data Format

NOTE

Certain addresses have two parts, the measured value and the exponent multiplier!

Voltage and current 0 to 9.999 without sign measured in [V, A], no exponent

Examples

U_{G12} = 103, exponent = 2

103×10^{2} [V] = 1,030 [V] = 10.3 kV

I_{G1} = 80, exponent = -1

80×10^{-1} [A] = 8.0 [A] = 8.0 A

Bit Change at Tripping of a Watchdog Function

If one of the watchdog functions (protective alarms) responds, the corresponding bits (for example bit 15/14 = overfrequency limit 2) will change from not tripped (= 0/1) to tripped (= 1/0).

Framework Data for the Interfaces

Framework Data for Procedure 3964 (TTY, RS-232, RS-485)

String length ..... 8 bit
Stop bit..... 1 bit
Parity bit ..... 1 bit with even parity
Idle state..... This corresponds to the state log. "1" (20 mA with TTY)
Data format..... 16 bit binary value
Transmission rate..... 9,600 Baud.
Other baud rates on request. The records are transferred cyclically.

RK 512 interpreter procedure: See Siemens documentation on procedure 3,964.

Framework Data for Hardware Handshaking RTS/CTS (RS-232, RS-422)

String length ..... 8 bit
Stop bit..... 1 bit
Parity bit ..... 1 bit with even parity
Idle state..... This corresponds to the state log. "1" (20 mA with TTY)
Data format..... 16 bit binary value
Transmission rate..... 9,600 Baud.
Other baud rates on request. The records are transferred cyclically.

Procedure: When the transmitter is ready for data transmission, it notifies the receiver of this by switching its control line RTS to "ON". The prerequisite of this is that no data are received (CTS = "OFF"). The receiver registers this status and indicates its readiness to receive by switching its RTS line to "ON". The transmitter can then begin transmitting when it detects this "ON" status on its CTS line. As soon as the receiver withdraws its RTS signal (RTS = "OFF"), the transmitter interrupts its transmission and waits until the receiver is ready to receive again. The initialization conflict (both subscribers set the RTS line simultaneously) and timeout (one subscriber waits in vain for a reply) must be taken into consideration.

Framework Data for Modbus RTU Slave

Transmitting protocol ..... MOD bus RTU slave
Hardware ..... Interface RS-485
Transmission rate..... adjustable
Slave address ..... adjustable
Parity..... adjustable

A maximum of 10 words can be read or 4 words written with one command. Modbus function codes 03, 04, 06 and 16 are supported.

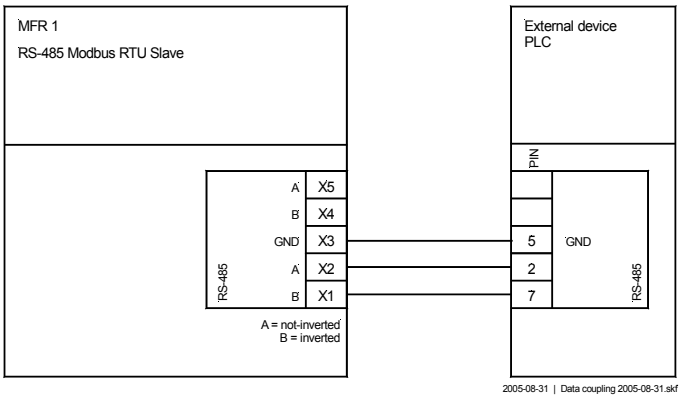


Figure 7–2: Interface - Modbus connection

Framework Data for CAN Bus

Transmitting protocol.....CAN (CiA)
Hardware.....CAN bus
Transmission rate .....adjustable
Special characteristic.....Bt0 = 03, Bt1 = 1C

Every 200 ms a data telegram of 8 bytes is sent, which is structured as follows (all word variables are in the high byte / low byte format):

Transmission Data

ID .....Base ID sending + CAN number

Byte 1 .....Multiplexer [1 to 9]
Byte 2 .....always 221
Byte 3/4.....1. data word (note table, no. 1), multiplexed (MUX = 1, 1)
Byte 5/6.....2. data word (note table, no. 2), multiplexed (MUX = 1, 2)
Byte 7/8.....3. data word (note table, no. 3), multiplexed (MUX = 1, 3)
Byte 9/10.....4. data word (note table, no. 4), multiplexed (MUX = 2, 1)
Byte 11/12.....5. data word (note table, no. 5), multiplexed (MUX = 2, 2)
etc.

Control Data (Option SB)

ID .....Base ID control + CAN number

A data telegram of 7 Bytes is expected, which is structured as follows (all word vari-ables are in the high byte / low byte format):

Byte 1 .....Multiplexer
Byte 2/3.....1. data word (note table, no. 1), multiplexed (MUX = 1, 1)
Byte 4/5.....2. data word (note table, no. 2), multiplexed (MUX = 1, 2)
Byte 6/7.....3. data word (note table, no. 3), multiplexed (MUX = 1, 3)
etc.

Configuration Data (Option SF)

ID .....ID configure (default value: 831)

No ID’s can be assigned twice in the system. This applies for all devices coupled to the bus system. Likewise all ID's set on the unit must be set to different values.

Procedure for base-ID transmission: All units available in the bus system are assigned to the same "Base ID transmission". The types of information are grouped in this way.

Example: The base ID transmission = 800 is used with all units. The individual ID's are assigned to the various unit numbers.

Unit number 1: ID = 801
Unit number 2: ID = 802
etc.

Procedure for base ID control: The same procedure applies for base-ID control. (Standard value 224)

Framework Data for Profibus DP

Receiving Range

Byte 0 and the following .... Telegram according to description

Example:..... No. 1 - Byte 0/1 = telegram header "302"
No. 2 - Byte 2/3 = voltage L12
No. 3 - Byte 4/5 = voltage L23
No. 4 - Byte 6/7 = voltage L31
etc.

Byte 185..... The bit 0 toggles every 2.5 seconds. This can be used for control if the interface still functions flawlessly.

Transmitting Range (Option SB)

Byte 0..... Block pre-selection (is not taken into account)
Byte 1..... The bit 0 is used as a watchdog. If monitoring is switched ON in the configuration screen, this bit must be toggle every 4 seconds. The unit monitors this and possibly triggers a fault and reinitializes the interface.
Byte 8/9 ..... Control word 1
Byte 10/11 ..... Control word 2
Byte 12/13 ..... Control word 3

Connection Example

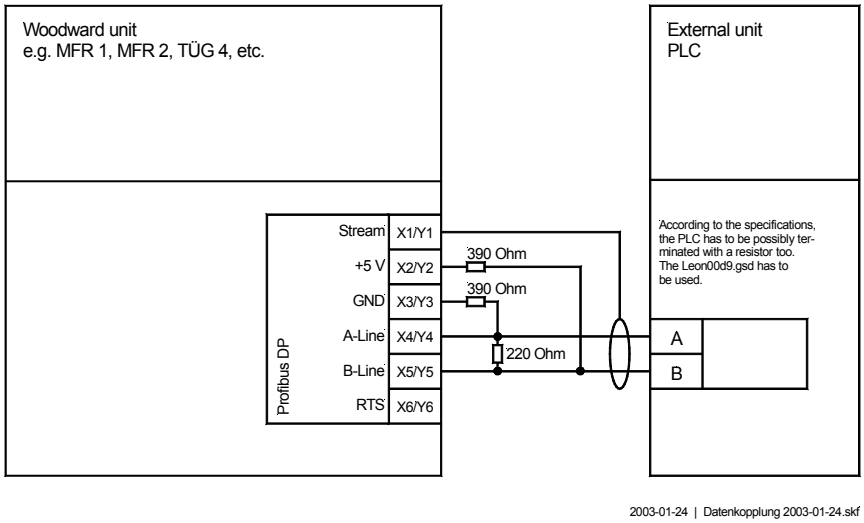


Figure 7-3: Interface, Profibus DP slave

Appendix E.
List of Parameters

Product number P/N _____ Rev _____

Version MFR 12_____

Project _____

Serial number S/N _____ Date _____

Pckg	Parameter	Setting range 100 V	Default setting	Customer setting	
BASIC DATA					
	Software version	-	-		
	SPRACHE/LANGUAGE	German/English	English	☐ G ☐ E	☐ G ☐ E
	Enter code number	0000 to 9999	-		
	Password Protection	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Define level 1 code	0000 to 9999	0001		
	Define level 2 code	0000 to 9999	0002		
	Direct parametr.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
MEASUREMENT					
	Volt.-Measuring	Phase to phase / Phase-neutral	Phase-neutral	☐ pp ☐ pn	☐ pp ☐ pn
	Volt.transformer secondary	50 to 125 V	100 V		
	Volt.transformer primary	00.100 to 65.000 kV	00.400 kV		
	Current transf.	[1] 1 to 9,999/1 A [5] 1 to 9,999/5 A	[1] 1,000/1 A [5] 1,000/5 A		
	Rated voltage	5 to 125 V	100 V		
	Rated current	10 to 9,999 A	1,000 A		
	Rated power	5 to 32,000 kW	500 kW		
	Power measuring	one-phase/three-phase	three-phase	☐ s ☐ t	☐ s ☐ t

Pckg	Parameter	Setting range 100 V	Default setting	Customer setting	
PROTECTION					
IS/IZ	Overcurrent Monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Overcurrent 1 I>	0 to 300 %	120 %		
..	Overcurrent 1 Delay	0.02 to 99.98 s	0.1 s		
..	Overcurrent 2 I>	0 to 300 %	160 %		
..	Overcurrent 2 Delay	0.02 to 99.98 s	0.04 s		
..	Overcurrent 3 I>	0 to 300 %			
..	Overcurrent 3 Delay	0.02 to 99.98 s			
IS/IZ	Overcurrent Hysteresis	1 to 300 %	5 %		
IA	Inv.time ov.curr Monitor.	ON/OFF	OFF	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Inv.time char.	Normal / High / Extreme	Extreme	☐ n ☐ h ☐ e	☐ n ☐ h ☐ e
..	Inv.time ov.curr Tp=	0.01 to 1.99 s	0.10 s		
..	Inv.time ov curr Ip=	0.1 to 3.0*In	1.0 *In		
IA	Inv.time ov.curr I start=	1 to 3.00*In	1.00 * In		
IU	Inv.time ov.cur. V-restr.	ON/OFF	OFF		
IU	Inv.time ov.curr Knee curve	10 to 90 %	20 %		
IV	Earth fault monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Earth fault Ve Response v.	3 to 100 %	0.50 %		
..	Earth fault Ve> Delay	0.02 to 99.98 s	0.1 s		
..	Earth fault Ve>> Response v.	3 to 100 %	1.00 %		
..	Earth fault Ve>> Delay	0.02 to 99.98 s	0.04 s		
IV	Release delay Earth f.v.	00.00 s			
IKN/IS	Earth current monitoring	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Earth current 1 Response	10 to 300 %	120 %		
..	Earth current 1 Delay.	0.02 to 99.98 s	0.1 s		
..	Earth current 2 Response	10 to 300 %	160 %		
..	Earth current 2 Delay	0.02 to 99.98 s	0.04 s		
IKN/IS	Earth current Hysteresis	0 to 300 %	5 %		
IV	Earth fault Ie restricted	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	Earth fault Ie Evalation	sin/cos	2.5 Hz/s		
..	Earth fault Ie Angle adj.	-180° to 180°	2.5 Hz/s		
IV	Earth fault Ie Block angle	00 to 10°	0.1 s		
RELAY CONFIGURATION					
	External Clearing	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Auto-clearing Relays	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
IZ	Release delay Overcurr.	0.02 to 99.98 s	0.10 s		
IU	Release delay Curr.-Inv	0.02 to 99.98 s	0.10 s		
IK/IS IKN	Release delay Earth F.	0.02 to 99.98 s	0.10 s		
IV	Release delay Earth F.v.	0.02 to 99.98 s	0.10 s		
	Auto-clearing Display	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
	Clearing display after	1 to 99 s	1 s		
	Change relay- allocation	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N
	Funct. relay 123 (R=release)	E/R	REE		
R	Funct. relay 45 (R=release)	E/R	EE		
R	Funct. relay 678 (R=release)	E/R	EEE		
IZ/IS	Overcurrent1 to relay	0 to 3/8	0002		
IZ/IS	Overcurrent2 to relay	0 to 3/8	0002		
IZ/IS	Overcurrent3 to relay	0 to 3/8	0002		
IU	Overcurrent (U<) 1 to relay	0 to 3/8	0002		
IU	Overcurrent (U<) 2 to relay	0 to 3/8	0002		
IK IKN	Earth Fault 1 to relay	0 to 3/8	0002		
IK IKN	Earth Fault 2 to relay	0 to 3/8	0002		
IV	E.fault Ve to relay	0 to 3/8	0003		
	Collect Response to relay	0 to 3/8			

Pckg	Parameter	Setting range 100 V	Default setting	Customer setting	
ANALOG OUTPUT CONFIGURATION					
A2/3/6 A1/4/8	**Analog output 1**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 1**	see table at the end of this parameter list	U L1-L2		
	Analog output 0/-10 mA 0/4/-20 mA		0 C		
A2/3/6 A1/4/8	**Analog output 10 V 20 mA**		400 V		
A3/6 A4/8	**Analog output 2**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 2**	see table at the end of the list of parameters	U L2-L3		
	Analog output 0/-10 mA 0/4/-20 mA		0 C		
A3/6 A4/8	**Analog output 10 V 20 mA**		400 V		
A3/6 A4/8	**Analog output 3**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 3**	see table at the end of the list of parameters	U L3-L1		
	Analog output 0/-10 mA 0/4/-20 mA		0 C		
A3/6 A4/8	**Analog output 10 V 20 mA**		400 V		
A4/6/8	**Analog output 4**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 4**	see table at the end of the list of parameters	Frequency		
..	**Analog output 0/-10 mA 0/4/-20 mA**		45.00 Hz		
A4/6/8	**Analog output 10 V 20 mA**		55.00 Hz		
A6/8	**Analog output 5**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 5**	see table at the end of the list of parameters	U L1-N		
..	**Analog output 0/-10 mA 0/4/-20 mA**		0 C		
A6/8	**Analog output 10 V 20 mA**		230 V		

Pckg	Parameter	Setting range 100 V	Default setting	Customer setting	
ANALOG OUTPUT CONFIGURATION					
A6/8	**Analog output 6**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 6**	see table at the end of the list of parameters	U L2-N		
..	**Analog output 0/-10 mA 0/4/-20 mA**		0 C		
A6/8	**Analog output 10 V 20 mA**		230 V		
A8	**Analog output 7**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 7**	see table at the end of the list of parameters	U L3-N		
..	**Analog output 0/-10 mA 0/4/-20 mA**		0 C		
A8	**Analog output 10 V 20 mA**		230 V		
A8	**Analog output 8**	OFF -20 to +20mA 0 to 20 mA 4 to 20 mA	-20 to.+20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA	☐ OFF ☐ -/+20mA ☐ 0-20mA ☐ 4-20mA
..		OFF -10 to +10 V 0 to 10 V	-10 to +10V	☐ OFF ☐ -/+10V ☐ 0-10V	☐ OFF ☐ -/+10V ☐ 0-10V
..	**Analog output 8**	see table at the end of the list of parameters	U L-L max value		
..	**Analog output 0/-10 mA 0/4/-20 mA**		0 C		
A8	**Analog output 10 V 20 mA**		400 V		
INTERFACE CONFIGURATION					
S3964	**Data block RK512**	0 to 255	0		
S3964	**Data word RK512**	0 to 255	0		
SPRO	**Device number Profibus**	0 to 126	1		
SMOD	**Device number MOD-Bus**	1 to 255	1		
..	**Baudrate**	1200 / 2400 / 4800 / 9600 / 19200 Baud	9600 Baud		
..	**Parity**	none/even/odd	none		
..	**Stopbits**	one/two	one		
SMOD	**Delay to send MOD-Bus**	0.2 to 50.0 ms	0.0 ms		
SCAN	**Device number CAN-Bus**	1 to 8	1		
..	**Baudrate**	125 / 250 / 500 kBaud	125 kBaud		
..	**Base-ID (send)**	0 to 2,015	800		
..	**Base-ID (remote)**	0 to 2,015	224		
SCAN	**ID (parameteriz.)**	0 to 2,015	831		
SB	**Serial control**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	**Serial interface Monitoring**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0
..	**Interface fault to relay**	0 to 3/8	0003		
SB	**Inhibit via Interface**	ON/OFF	ON	☐ 1 ☐ 0	☐ 1 ☐ 0

Value	Lower and upper setting value	
	0 V, -10 V 0 mA, 4 mA, -20 mA	10 V, 20 mA
V L1-N1	0 to 65,000 V	
V L2-N1	0 to 65,000 V	
V L3-N1	0 to 65,000 V	
V L-N mean value1	0 to 65,000 V	
V L-N max. value1	0 to 65,000 V	
V L-N min value1	0 to 65,000 V	
V L1-L21	0 to 65,000 V	
V L2-L31	0 to 65,000 V	
V L3-L11	0 to 65,000 V	
V L-L mean value1	0 to 65,000 V	
V L-L max. value1	0 to 65,000 V	
V L-L min. value1	0 to 65,000 V	
Frequency1	40.00 to 80.00 Hz	
I L1	0 to 9,999 A	
I L2	0 to 9,999 A	
I L3	0 to 9,999 A	
I 1-3 mean value	0 to 9,999 A	
I 1-3 max. value	0 to 9,999 A	
I 1-3 min. value	0 to 9,999 A	
I L1 (+/-)1,2	-9,999 to +9,999 A	
I L2 (+/-)1,2	-9,999 to +9,999 A	
I L3 (+/-)1,2	-9,999 to +9,999 A	
I 1-3 (+/-) mean1,2	-9,999 to +9,999 A	
I 1-3 (+/-)max1,2	-9,999 to +9,999 A	
I 1-3 (+/-)min1,2	-9,999 to +9,999 A	

[1] Only if the Option IU or IR is included.
[2] The sign of the current values is defined by the polarity of the active component.

Table 7-1: Analog outputs, table of values

Appendix F.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (refer to "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part numbers (P/N) and serial number (S/N);
- description of the problem;
- instructions describing the desired repair.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart [+49 (711) 789 54-0]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the unit(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (711) 789 54-0 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part numbers P/N (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number S/N, which is also on the nameplate.

How to Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (711) 789 54-0 (8.00 - 16.30 German time)
Fax: +49 (711) 789 54-100
e-mail: stgt-info@woodward.com

For assistance outside Germany, call one of the following international Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Facility	Phone number
USA	+1 (970) 482 5881
India	+91 (129) 409 7100
Brazil	+55 (19) 3708 4800
Japan	+81 (476) 93 4661
The Netherlands	+31 (23) 566 1111

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail, or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, through our authorized distributors, or through GE Global Controls Services, depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, at your location, or from GE Global Controls Services, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facility in Colorado, or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***field service***.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company_____

Your name_____

Phone number _____

Fax number _____

Control (see name plate)

Unit no. and Revision: P/N:_____ REV: _____

Unit type MFR 12_____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

Woodward GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (711) 789 54-0 • Fax +49 (711) 789 54-100
stgt-info@woodward.com

Homepage

http://www.woodward.com/power

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